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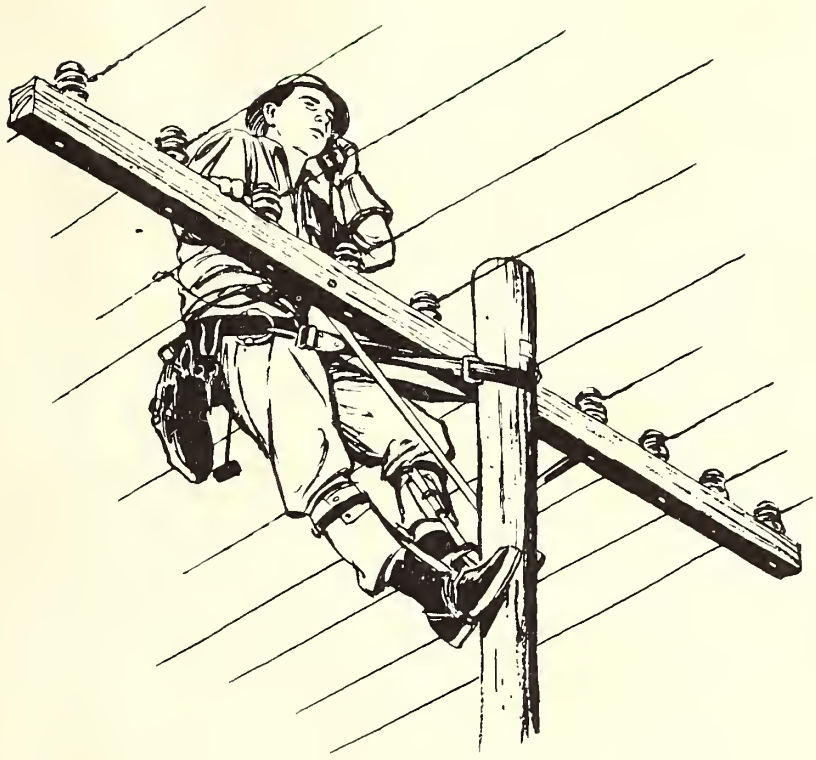

## Southeastern
# WOOD POLE CONFERENCE

## May 15-17, 1963

## University of Florida, Gainesville

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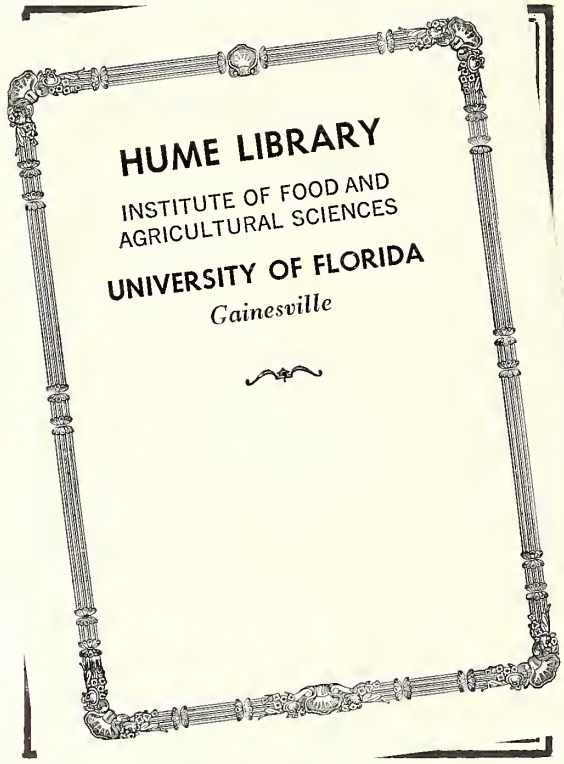
1963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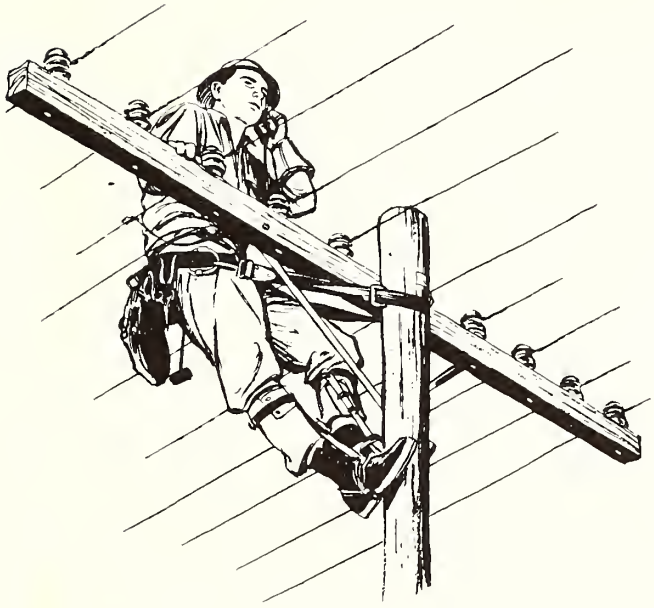
# Proceedings



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# TABLE OF CONTENTS


Southeastern Wood Pole Conference Program . . . . . iv

Conference Directory . . . . . vi

Foreword . . . . . viii

The Importance of Better Wood Poles for Your Utility . . . . . 3

Properties of Wood . . . . . 7

The Importance of Proper Pole Handling . . . . . 19

The Treating Process; Quality Control Procedure . . . . . 25

Pole Performance . . . . . 37

Purchasing Practice and Problems of an Independent Telephone Company . . . . . 47

Purchasing Practice and Problems of a Municipal System . . . . . 51

Purchasing Practice and Problems of a Major Utility . . . . . 55

Current ASA Standards . . . . . 59

Realistic Wood Pole Specifications . . . . . 71

Recent Changes in NES Code. . . . . 77

Preventing Bird Damage . . . . . 89

Extending Wood Pole Life in Plant . . . . . 97

Kinds of Preservatives for Wood Poles . . . . . 107

Retention and Service Performance . . . . . 113

## SOUTHEASTERN WOOD POLE CONFERENCE

**May 15-17, 1963**

### WEDNESDAY, MAY 15

**Morning:**

8:00 Registration

9:00 Welcome ..... J. W. Willingham

C. M. Kaufman, Presiding

9:15 Keynote Address ..... Paul Wayman

10:00 Properties of Wood ..... Jacob B. Huffman

10:30 Discussion

10:45 Break

11:00 The Importance of Proper Pole Handling ..... R. Bert Hawk

11:45 Discussion

12:30 Lunch

**Afternoon:** Harold M. Bennett, Presiding

2:00 The Treating Process ..... Monie S. Hudson

2:45 Discussion

3:00 Break

3:15 Quality Control Procedures ..... Monie S. Hudson

4:00 Discussion

**Evening:**

6:00 Social Hour

7:00 Dinner; Speaker ..... Frank Goodwin

### THURSDAY, MAY 16

**Morning:** I. L. Garcia, Presiding

8:00 Pole Performance ..... Orville Zastrow

8:45 Discussion

9:15 Break

9:30 Purchasing Practice and Problems

Independent Telephone Companies ..... C. C. Leiby
W. H. Hawkins

Municipal System ..... Walter H. Norman

REA Borrower ..... James H. Phillips

Major Utility ..... R. F. Connolly

11:00 Discussion

12:00 Lunch

**Afternoon:** J. Alvin Vaughan, Presiding

1:30 Current ASA Standards ..... L. G. Smith

2:30 Discussion

2:45 Break

3:00 Realistic Wood Pole Specifications ..... James A. Taylor

4:00 Discussion

4:30 Quality Wood Poles for Street Lighting ..... W. M. Barnes

5:00 Discussion

## FRIDAY, MAY 17

**Morning:** James H. Phillips, Presiding

8:00 Purposes of the American Wood Preservers Institute ..... Robert O. Hawes

8:30 Recent Changes in NES Code (in relation to wood poles) ..... Stanley Warth

9:00 Discussion

9:30 Preventing Bird Damage ..... John V. Dennis

10:00 Discussion

10:30 Break

10:45 Extending Wood Pole Life in Plant ..... E. L. Lancaster

11:30 Discussion

12:00 Lunch

**Afternoon:** J. Alvin Vaughan, Presiding

1:30 - 4:00 Preservatives and Retentions

1:30 Kinds of Preservatives for Wood Poles ..... James N. Roche

2:00 Movement of Preservatives in Poles ..... Willard Leach

2:30 Break

2:45 Retention and Service Performance ..... Charles A. Burdell

3:15 Discussion

4:00 Conclusion– Presentation of Certificates ..... Robert L. Fairing

## CONFERENCE DIRECTORY

### STAFF

W. M. Barnes, Koppers Company, Inc., Charleston, South Carolina

Harold M. Bennett, Vice President, Sales, The Langdale Company, Valdosta, Georgia

Charles A. Burdell, Research Engineer, Southern Wood Preserving Company, Atlanta, Georgia

R. F. Connolly, Director, Purchasing and Stores, Tampa Electric Company, Tampa

John V. Dennis, Biologist, Koppers Company, Inc., Leesburg, Virginia

Robert L. Fairing, Head, Department of Citizenship and Community Development, Division of General Extension, Gainesville

I. L. Garcia, General Engineer, Florida Power Corporation, St. Petersburg

Frank Goodwin, Professor, Marketing, College of Business Administration, University of Florida

Robert O. Hawes, Executive Vice President, American Wood Preservers Institute, Chicago 2, Illinois

R. Bert Hawk, T. R. Miller Mill Company, Inc., Brewton, Alabama

W. H. Hawkins, Inter-County Telephone Company, Ft. Myers

Monie S. Hudson, Consulting Chemist, Spartanburg, South Carolina

Jacob B. Huffman, Associate Professor, School of Forestry, University of Florida

C. M. Kaufman, Professor, School of Forestry, University of Florida

E. L. Lancaster, Transmission and Distribution Engineer, Louisiana Power and Light Company, New Orleans, Louisiana

Willard Leach, Technical Supervisor, Applied Research Laboratory, United States Steel Corporation, Monroeville, Pennsylvania

C. C. Leiby, Vice President, Florida Telephone Company, Ocala

Walter H. Norman, Director of Purchases, Orlando Utilities Commission, Orlando

James H. Phillips, General Manager, Florida Keys Electric Cooperative Association, Inc., Tavernier

James N. Roche, Tar Products Division, Koppers Company, Inc., Pittsburgh, Pennsylvania

L. G. Smith, General Superintendent, Engineering and Construction, Baltimore Gas and Electric Company, Baltimore, Maryland

James A. Taylor, Timber Products Supervisor, Rural Electrification, Administration, United States Department of Agriculture, Washington, D. C.

J. Alvin Vaughan, Consultant, Crystal River

Stanley Warth, Florida Transmission and Protection Engineer, Southern Bell Telephone and Telegraph Company, Jacksonville

Paul Wayman, Assistant Vice President, Koppers Company, Inc., Pittsburgh, Pennsylvania

J. W. Willingham, Acting Director, School of Forestry, University of Florida

Orville Zastrow, Electrical Engineer, Electric Standards Division, Rural Electrification Administration, United States Department of Agriculture, Washington, D. C.

## THE SOUTHEASTERN WOOD POLE COMMITTEE

Chairman—I. L. Garcia, General Engineer
Florida Power Corporation, St. Petersburg, Florida

Vice-Chairman—J. H. Phillips, Vice Manager
Florida Keys Electric Cooperative Association, Tavernier, Florida

Secretary—C. M. Kaufman, Professor
School of Forestry, University of Florida

W. M. Barnes, Manager, Southeastern District, Wood Preserving Division, Koppers Company, Inc., Charleston, South Carolina

J. T. Bayer, Division Engineer, Southern Bell Telephone and Telegraph Company

Harold M. Bennett, Vice President, Sales, The Langdale Company, Valdosta, Georgia

Jack T. Dingley, Sales Manager, Southern Division, Osmose Wood Preserving Company, Griffin, Georgia

Robert L. Fairing, Head, Department of Citizenship and Community Development, Division of General Extension, Gainesville

R. Bert Hawk, Plant Superintendent, T. R. Miller Mill Company, Brewton, Alabama

Jacob B. Huffman, Associate Professor, School of Forestry, University of Florida

John R. Kelly, Director, City Utility Department, Gainesville

E. T. Sullivan, Associate Professor, School of Forestry, University of Florida

J. Alvin Vaughan, Consultant, Box 14, Crystal River, Florida

O. L. Vickers, Operations Supervisor, Satilla Rural Electric Membership Corporation, Alma, Georgia

Leon E. Weaver, Manager, Talquin Electric Cooperative, Quincy

W. C. Wingard, Manager, Central Alabama Electric Cooperative, Prattville, Alabama

Clarence R. Wood, Field Engineer, Rural Electrification Administration, Ocala

## ADMINISTRATION

**The Florida Institute for Continuing University Studies**

Myron R. Blee, President, Tallahassee

**Division of General Extension, Gainesville**

G. Manuel Turner, Dean
Robert L. Fairing, Coordinator for the Conference

**School of Forestry, University of Florida**

J. W. Willingham, Acting Director
J. B. Huffman, In Charge of Technical Program for the Conference

# FOREWORD

The need and importance of this second Southeastern Wood Pole Conference is attested to by your presence. In any area of human activity where large numbers of complex objects or materials such as wood poles are involved, a multitude of problems always arise in connection with the processing, trade and use of these materials. A conference such as this cannot possibly solve all the problems, but only by an exchange of information and ideas can we expect progress. Seventy-five percent of the nation's requirements for poles are met by southern yellow pine – the best wood pole material available anywhere. It is only fitting that we here in Florida and the Southeast make a special, enthusiastic effort to take this good product and strive to make it better.

We are indebted to all members of the Southeastern Wood Pole Committee who have attended numerous meetings during the past three years, devoting much time and energy to laying the groundwork and making plans for this conference. We owe a special debt of gratitude to Committee Chairman, I. L. Garcia.

We are also indebted to the gentlemen who will present information and lead discussions during the three days of this conference. They have spent many years in acquiring the knowledge and experience so essential to the betterment of the wood pole industry. Their contributions constitute the heart of the Conference.

It is a real pleasure to be associated with the people who are responsible for and have taken initiative in organizing and presenting the 1963 Southeastern Wood Pole Conference.

Speaking for the School of Forestry and the University of Florida, I wish to welcome you here, and to thank all of you for helping make this, the second Southeastern Wood Pole Conference, a success.

J. W. Willingham

# THE IMPORTANCE OF BETTER WOOD POLES FOR YOUR UTILITY

## KEYNOTE ADDRESS

By

Paul Wayman, Assistant Vice President

Koppers Company, Inc.

Pittsburgh, Pennsylvania

## THE IMPORTANCE OF BETTER WOOD POLES FOR YOUR UTILITY

I sincerely appreciate this opportunity to participate in this year's Southeastern Wood Pole Conference and I am particularly honored to have been asked to present the keynote remarks to these discussions. Maintaining and improving the quality of poles holds great interest for all of us; the University of Florida's School of Forestry, the Florida Institute For Continuing Studies, together with the Southeastern Wood Pole Committee are to be commended for getting this group together to again consider this important subject.

The need for discussions of this kind is accentuated by today's highly competitive conditions which tend to place undue emphasis on initial price at the sacrifice of quality and long term economy. Some of you, I am sure, saw the recent advertisement of Minnesota Mining & Manufacturing Co. discussing the tendency on the part of some buyers to overlook the importance of quality. The 3 M ad used the term "Brand X" to denote inferior products and raised the thought provoking question as to what would happen "If Everybody Made 'Brand X'." The ad read in part as follows:

> "Can you think of a product that would be easier to build than Brand X? After all, Brand X never has many features. . .it's never very advanced. . .and it can be sold profitably at a very low price.
>
> You can use the cheapest materials. Forget about quality control. Eliminate research. Stop inspections. Ignore customer service needs. Keep production moving, moving, moving. But hang the quality.
>
> So what would happen if every manufacturer decided to build Brand X?
>
> You'd get things dirt cheap.
>
> But they wouldn't get you anywhere. You couldn't depend on them. Your standard of living would slip. Your industrial output would fall. America would turn into a giant junk yard within a very few years.
>
> Could it happen? Probably not. There just are not enough "price-conscious" customers to buy the output of all those Brand X factories. There just aren't enough customers who think value isn't important. Yet, there will always be some people who think it's silly to "pay for the name" of a reputable product when Brand X and even Brand X-minus are such wonderful bargains."

I am sure that after this Conference, no one will be tempted by low priced – low value "Brand X" poles and that we will all be further impressed with the importance of quality to long term pole line economy.

At the 1960 Southeast Wood Pole Conference, Mr. J. W. Davis of the Southern Bell Telephone & Telegraph Company estimated that the nation's electric power and communications systems had 125 million poles in service and that it would cost 25 billion dollars to replace them. We all know that high quality poles can last a long time, in some cases, 50 years or longer. But, assuming an average pole life of 25 years, the annual cost of replacing these 125 million poles would be one billion dollars per year. With good quality poles, averaging 35 years life, the replacement cost would be reduced by over 28 per cent of 714 million dollars. Certainly the replacement bill is enormous in either case but the savings of 286 millions resulting from increasing the average life of the poles from 25 years to 35 years certainly provides a very real incentive to the utility and communications companies to buy high quality poles.

Billions and millions are hard to comprehend so let's consider that the replacement of the average pole in Mr. Davis' statistics costs $200. Obviously, it could cost more than $1,000 to replace some transmission poles and much less than $200 to replace some small distribution or service poles. Based on the $200 average, the replacement cost of a 25 year pole will be $8.00 per year and this same cost for a 35 year pole will be only $5.71 per year. This potential savings of $2.79 per year or $57.25 per pole calculated over 25 years further illustrates the economy of buying poles which will give long life in service.

As I said previously, my calculations are arbitrarily based on 25 years and 35 years, but we all know many instances where average pole life has exceeded both of these figures. Many of you have no doubt driven south from Petersburg, Virginia, and have been impressed by the great number of

sawn creosoted pine poles still standing after some 65 years of service. Others of you may be familiar with the careful records kept by the Public Service Electric and Gas Co. (Newark, N. J.) and know that failures from decay only reached 1% between the 25th and 26th year of service. This percentage is still too small to permit calculating the average life of these poles.

Of course, along with the many good examples of long pole life, there have been some exceptions where utility poles have remained in service only a short period of time. It must be said that there have been instances of inept management and unskilled production on the part of some pole suppliers, the results of which were disastrous to the customer. But we must also consider that perhaps many of the early failures were bought by people who shopped too hard for the lowest priced poles.

When considering quality, I think we should ask ourselves "what do utilities really want from their poles?" One way of looking at it is that they do not really want poles. They want such important things as continuous service, freedom from costly outages, they want safety for their public and for their employees. They want to continue overhead distribution and service for the sake of economy. They want to build up the communities they serve. They have a real feeling of responsibility and good citizenship. For many years they have used treated wood poles to achieve their objectives. Whether or not they will continue to use wood poles will depend upon changing conditions and how well wood poles will meet these new conditions.

Over the years there have been many improvements in the selection, care, handling and treating of poles which have resulted in increased pole strength and pole life. Some changes have been made which have improved pole appearance. Marketing and distribution methods have been improved making poles more readily available and reducing distribution costs. The new Assay method for determining perservative retention is also a big step forward in assuring quality poles. Other and more recent improvements will be discussed during this meeting.

The electric utility industry not only is our fastest growing industry-it probably also ranks first in innovation. The tremendous expansion programs that are planned involving such things as atomic power plants, pumped storage hydro units, reversible pump-turbines, automation using computer controls and programming, coal transport by pipeline, extra high voltage transmission and exchange of power on a nationwide and even international basis are beyond comprehension of the layman. It is not reasonable to assume that this growth and these changes can be made without having some effect on pole requirements.

While we believe we have been correct in continuing to direct our thinking and research toward longer and longer lasting wood poles, we must recognize that there may be qualifications other than long life which poles must meet in the future. Perhaps there are improvements which you want or need in poles now that are not available to you. It would be a real contribution to the success of this meeting if you will speak plainly on this subject during the discussion period.

Perhaps you need poles which are perfectly clean, dry, paintable and lighter in weight. Perhaps you need transmission arms that are free of defects, that are dry before installation to eliminate the deep checks inherent in the drying of large, solid timber, and that are available in any lengths and cross sections. Such an arm is available today. It is made from kiln dried southern yellow pine, laminated together with the same glue used in PT boats, and it takes perservative readily. Similar material has been used as stringers on railroad trestles since 1941, a far more rigorous service than as a transmission cross arm.

Nowadays, most betterments are a team effort. All the teammates are not here – back home in the offices and laboratories are many fine minds trained in various sciences and professions who might help with an improvement, provided they knew of your need. Better Poles for Your Utility has a past that we should remember, it has a present that will be clearer to us from this conference, and it has a future related to our participation in this conference.

I am sure I speak for all of us when I say thank you to each of those responsible for the planning and work on this program. I am looking forward to the comments of the speakers and to the discussions of their papers. I will not delay the presentations longer except to remind you that we have a treating plant here in Gainesville. We would be very happy to have any or all of you visit us Friday afternoon after the close of the conference.

# PROPERTIES OF WOOD

By

Jacob B. Huffman, Associate Professor

School of Forestry, University of Florida

# THE STRUCTURE AND PROPERTIES OF WOOD FOR SOUTHERN PINE POLES

## Introduction

The central topic for discussion during this conference is wood, or more specifically, wood poles. If any discussion on wood poles is to have significant meaning and depth, a knowledge of the base material – wood – is extremely helpful if not absolutely essential. Knowledge pertaining to the nature, properties and complexity of wood is undoubtedly quite varied among the participants in this conference. We are from different backgrounds, we have been trained in various fields; even now, our individual responsibilities in connection with the processing or use of wood poles is quite varied.

Regardless of our background and responsibilities, we all feel we know what wood is and how it acts; we see it and use it everyday. But, if we take a closer look, we will come to realize that wood as a structural material is extremely complex and variable in nature. It is a material with many attributes but it also has its shortcomings. The attributes and faults of wood are directly related to its physical structure and chemistry. A knowledge of these subjects is basic therefore to an understanding of such factors as wood quality, strength, durability, treatability and of the specifications that relate to these factors. Whatever our connection with wood poles may be, it is certain that the better we know and understand wood, the better job we can do in meeting our responsibilities.

## GROSS STRUCTURE

All of us are familiar with the classic view of the cross section of a tree. In the center of such a section, one can see the pith which is the vertical or longitudinal axis of the standing tree. Around the pith are the successive annual growth layers or rings of wood. On the outside, there is the bark. For a closer examination of the features of wood that can be identified with the unaided eye let us refer to Figure 1, which depicts a pie-shaped section taken from the cross section of a tree.

The bark of the tree is composed of two layers. The outer bark protects the tree from mechanical damage and prevents the loss of moisture from the inner tissues. The inner bark serves as a passageway for the movement of sap from the leaves to the roots, to the cambium or growing layer, and to the outer portion of the sapwood. The bark of a healthy tree also serves as a protective layer against attack by insects and fungi. When a tree is felled to make a pole, it is important that all of the bark be removed to facilitate the drying of wood, and later, to permit the movement of a chemical preservative into the wood. If bark is not removed soon enough, the pole is subject to attack by wood-damaging insects and fungi.

The woody portion of a tree between the cambium and the pith, is usually composed of a sapwood zone and a heartwood zone. In living trees, the sapwood zone is physiologically active; that is, it contains some living cells. The long, vertically oriented cells in the outer portion of the sapwood zone conduct water and nutrients from the roots to the leaves; the smaller, living wood-ray cells conduct water and nutrients laterally in the stem. The sapwood is always light in color, it usually contains large quantities of water and it is highly susceptible to attack by insects and fungi. Fortunately, sapwood is quite permeable to liquids and therefore it seasons rapidly and is readily penetrated with preservatives.

When sapwood ages, the living cells die, chemical substances called "extractives" are deposited in the cells, usually causing a darkening in color. Thus the sapwood is transformed into heartwood. In some species of wood, these extractives are toxic to insects and fungi, and if this be the case heartwood will exhibit some resistance to the attack of these organisms. The same extractives may also prevent the movement of toxic preservatives into the heartwood zone. Young trees usually contain little or no heartwood. In the southern pines, the heartwood begins to form when the tree is about twenty to thirty years of age. Generally speaking, pole-size pine timber contains relatively little heartwood.

All of us are aware of the fact that most tree species in the temperate zones of the world add one

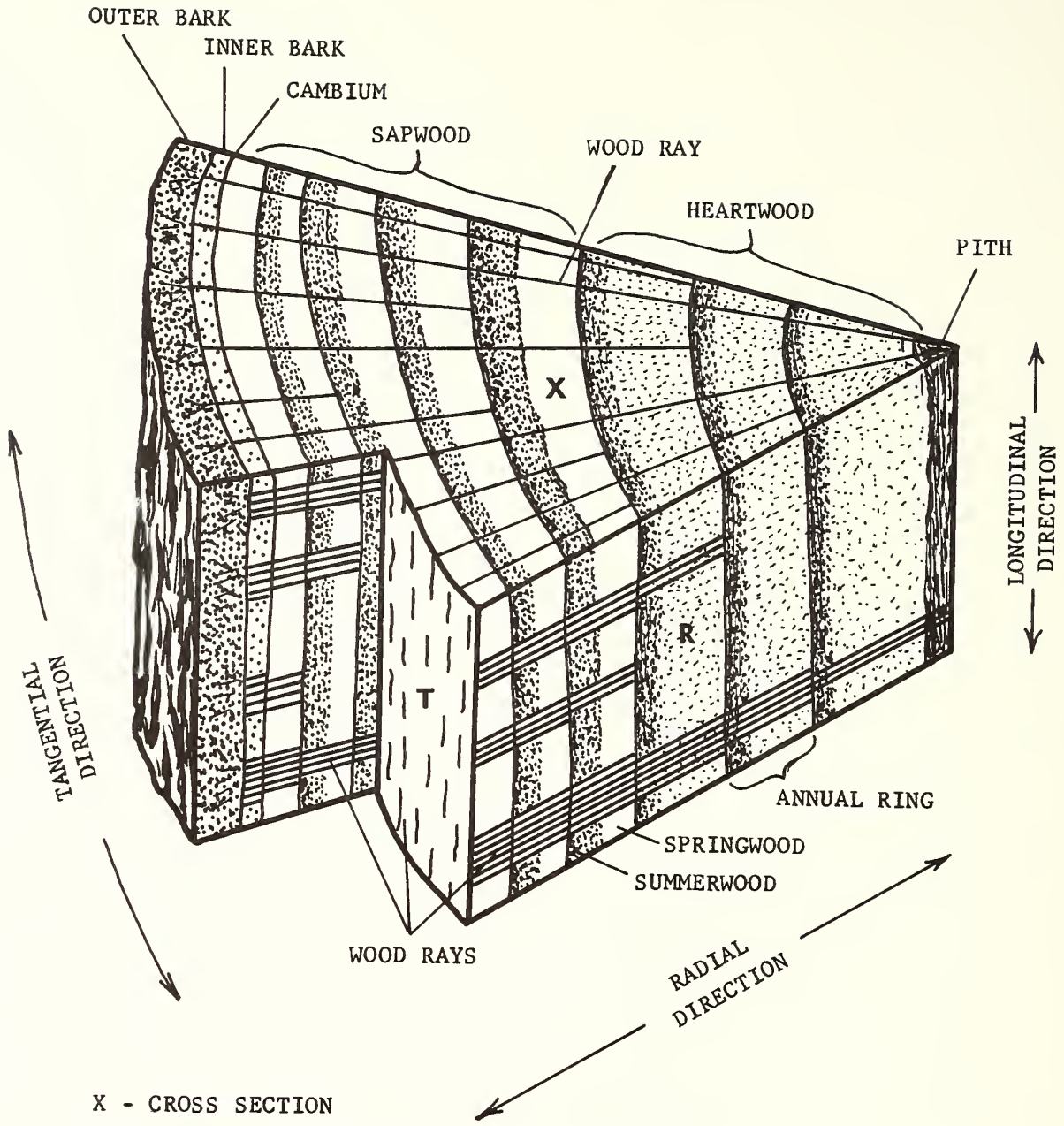


FIGURE 1. - Gross Structural Features Of A Log

new layer of wood each year. During the growing season, new wood cells are produced by the division of the living cells in the cambium. The successive layers as viewed on the cross section or radial surfaces of the stem are called annual growth rings. The inner part of each ring, that portion which is formed during the early part of the growing season, is called springwood, the outer part, formed later in the season, is called summerwood. In the southern pines, the springwood cells have thin walls, relatively large cavities and are light in weight and color. The summerwood cells have thick walls and small cavities; they are heavy and darker in color. (The dark color of summerwood is due to the greater density of the wood and not because it contains more resinous extractives. In fact, the springwood generally contains more resinous materials than summerwood): As shall be discussed later, many of the properties of wood, and of wood poles, are directly related to the proportion of springwood to summerwood in the tree stem.

Approximately 90 to 93 percent of the wood volume in the southern pines is comprised of long, thin, wood fibers (tracheids) which are oriented vertically in the standing tree or in the so-called longitudinal direction. Wood ray-cells are responsible for the remaining volume of the tree. Rays are ribbons of wood tissue oriented in a radial direction from the pith towards the bark. In pine, the rays are mostly one cell wide and one to many cells high; they are inconspicuous to the unaided eye. As previously stated the rays serve as avenues for the lateral movement of liquids and plant nutrients. Since they occur between the longitudinal elements and are oriented in a different plane, they create points of weakness in a timber. When wood begins to dry, this weakness is revealed by the appearance of small fissures or checks in the wood. The occurrence of checks in poles does not materially affect strength; however, checks can be a cause for concern if, following preservative treatment, they extend inside the treated zone and expose unprotected wood.

## MICROSCOPIC STRUCTURE

Some properties of wood are more easily understood if one studies the microscopic structure of the material. Figure 2 is a drawing of a small cube of a typical coniferous wood; the nature of numerous microscopic features are revealed. On the upper transverse surface may be seen portions of two annual rings. The character of the typical thin-walled springwood tracheids and the thick-walled summerwood tracheids is disclosed. Each wood cell has a cavity (lumen) which explains the large void volume or porous nature of wood. Attention is called to the relative size and position of the wood rays and of the longitudinal tracheids as viewed from various aspects. A typical and prominent feature of some coniferous woods is discernable in Figure 2; namely, the resin canals. These tube-like, intercellular spaces, oriented both vertically (large) and horizontally (small) are scattered infrequently throughout resinous woods like pine. The specialized epithelial cells which form the walls of these canals secrete resins that add to the extractive content of wood, and especially in the heartwood of southern pine. Observing Figure 2, one can see that the wood is a complex aggregate of many different types of individual cells. The cells are bound tightly together with an intercellular adhesive substance called lignin, On a dry-weight basis, approximately 25 percent of wood substance is lignin, 70 percent is cellulose and less than 1 percent is mineral matter. Extractives are not an integral part of wood substance but they may be present in amounts ranging from minute quantities to more than 30 percent of the dry wood weight.

A question might now be logically raised as to how liquids, including preservatives, pass from one cell to another if the cells have definite walls and are bound tightly together with lignin. The answer lies in the presence of numerous, intercellular pits (small gaps or openings) that are present in the walls of adjacent cells. These small circular openings of different sizes can be seen in Figure 2. Between each matching set of pits in adjacent cell walls, a membrane across the opening controls the movement of materials. When sapwood changes into heartwood, the structure of the pit membrane is altered slightly, and this tends to block off or reduce the passage of materials. Resinous extractives may also be deposited on the pit membrane to further reduce the permeability of heartwood. This is the reason why it is impossible to impregnate southern pine heartwood with most preservatives.

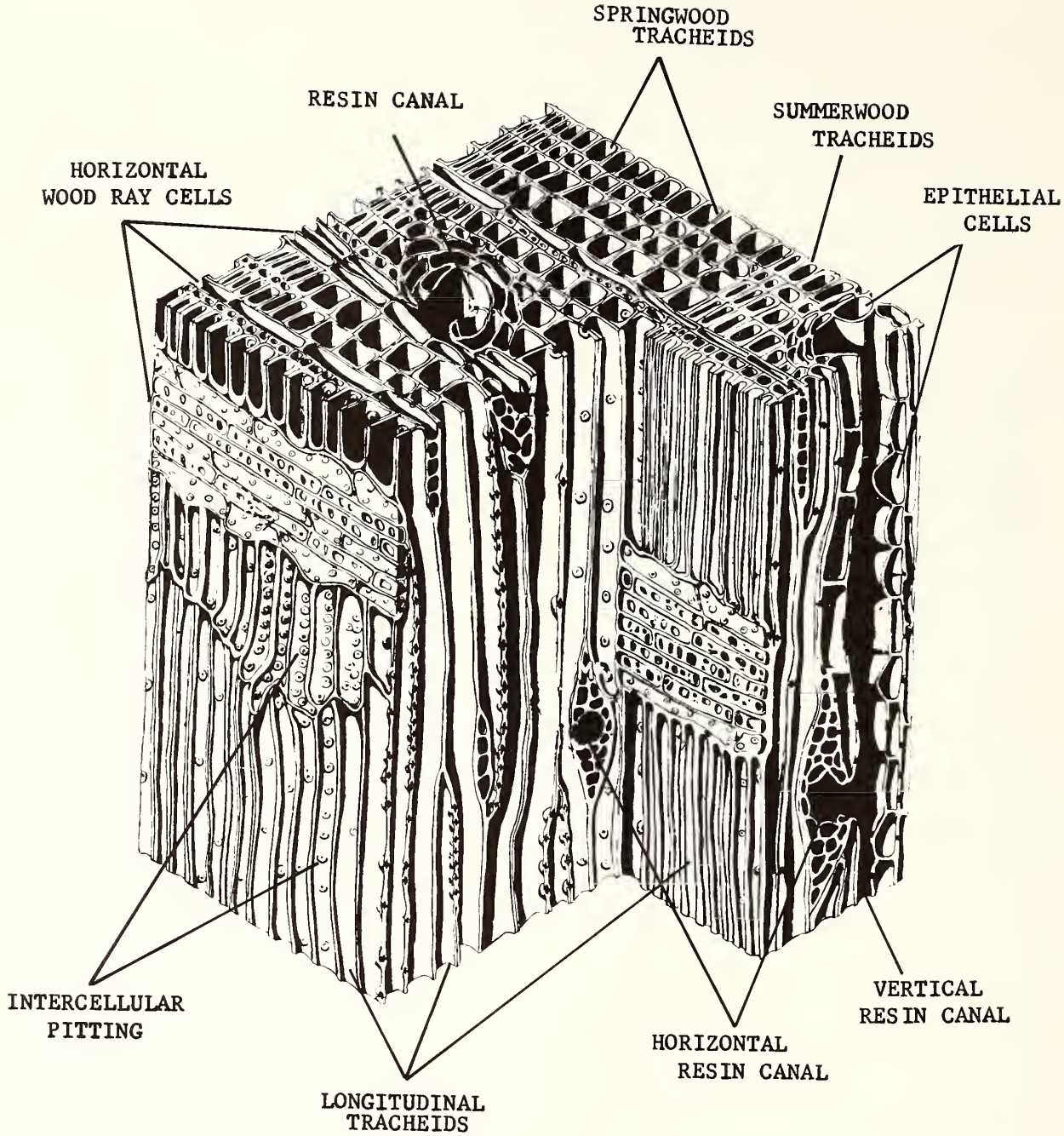


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Figure 2. - Drawing of a small cube of a typical coniferous wood. (Photo courtesy of the U.S. Forest Products Laboratory)

Observing wood microscopically, one can see how the long, slender, hollow wood fibers with tapering ends intermesh and overlap one another to form a lightweight but tight, interlocking system. Each wood cell is, in essence, a minute cylinder, known to be one of the strongest of geometric shapes. The walls of wood fibers are basically cellulose, built up with bundles (fibrils) of long-chain cellulose molecules, most of which are oriented more or less parallel to the long axis of the fibers. When studied in greater detail, it will be observed (Figure 3) that the cell wall is comprised of several layers. The second or middle layer of the secondary wall is most prominent and the direction of the fibrils in this layer determine strength and shrinkage characteristics of the wood. If the majority of fibrils are close to the vertical (small angle), as in normal wood, the wood is strong in bending; on the other hand, if it is more horizontal (large angle), as in compression wood, the wood is weak in bending and is unfit for a pole timber.

The direction of the fibrils is responsible for the fact that wood shrinks mostly in a radial and tangential direction when it dries. In green or wet wood, water molecules are located between special bundles of cellulose chains called "crystalites" keeping them apart laterally (not longitudinally). When normal wood begins to dry below what is called the fiber saturation point, the wood will begin to shrink in a lateral direction as the water molecules move out. Compression wood (Figure 4) which is abnormal wood, with most of its fibrils oriented in a horizontal position, will shrink more longitudinally and may be the ultimate cause of cross-breaks in a timber if it is present in quantity near the surface.

## WOOD PROPERTIES

### Wood-moisture relationships

The interrelation between wood and water is of great importance to the wood pole industry. Moisture content has a direct bearing on the susceptibility of wood to attack by wood-staining and wood-decay fungi and insects. The amount of water and the manner of its removal from wood affects the the weight and strength of a pole. Before wood can be treated with a preservative to render it durable for long years of service it must be seasoned or conditioned in order to obtain deep penetration of a sufficient quantity of a toxic preservative to prevent decay.

It is customary to express the amount of water in wood as a percentage of the wood's ovendry weight. For example, if a piece of wood weighs 6 pounds when wet and 3 pounds when ovendry, its moisture content would be:

$$\frac{6-3}{3} \times 100 = 100 \text{ percent}$$

In freshly cut southern pine poles, the moisture content of sapwood ranges from 100 to 130 percent while that of the heartwood is between 30 to 50 percent. Actually, there are two kinds of water in wood; free water and bound water. Free water is the water that is contained in the cell cavities or openings; while bound water is that which occurs within the cell walls, molecularly attracted to the cellulose. Water moves through wood from cell to cell by capillary action via the pits and by diffusion through the cell walls. Wood dries by the evaporation of moisture from its surfaces. If all the free water in the cell cavities of wood is removed but the walls are still fully saturated, the moisture content is about 30 percent. This point is called the fiber saturation point. As bound water is removed from the cell wall, the wood begins to shrink. It will continue to shrink in almost direct proportion to the amount of water removed. Total shrinkage of normal southern pine wood from the wet to ovendry condition averages about 7.4 to 7.8 percent tangentially and 4.4 to 5.5 percent raidally. Shrinkage is negligible longitudinally. The rate and extent of moisture removal will depend on the temperature, humidity and circulation of the air as well as the shape, size and permeability (depends on extractive content) of the wood.

Nondurable wood that is below 20 percent moisture content is not subject to attack by decay and stain fungi; therefore, rapid surface drying of freshly cut poles is a partial answer to preventing fungus attack. If wood is re-wetted however and the moisture content rises above 20 percent, the wood may once more be subject to attack.

The attack of blue stain fungi in freshly cut poles will increase the water-absorbing qualities of wood. Reabsorbtion of rain water into dry, blue-stained wood immediately prior to preservative treat-

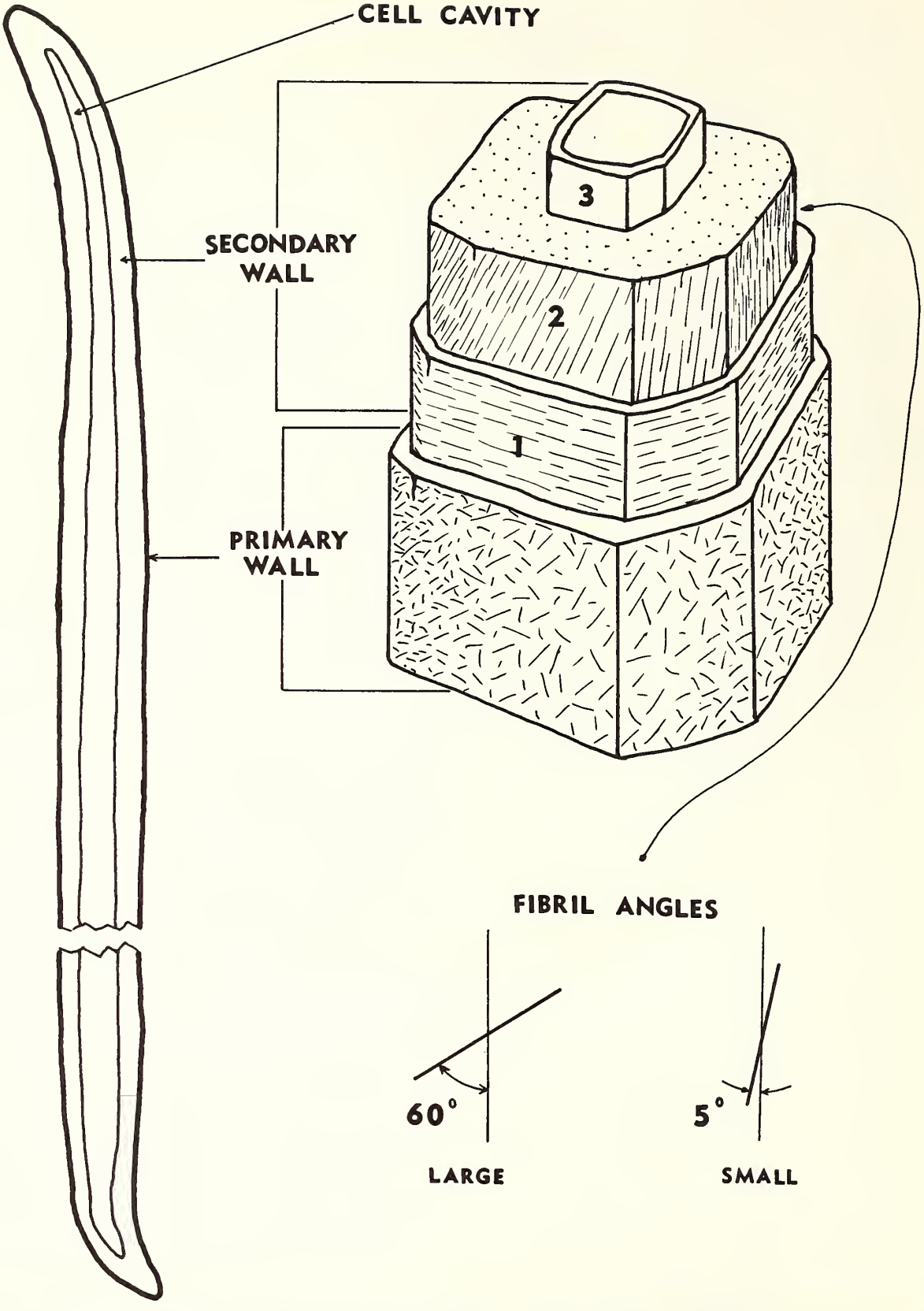


Figure 3.- Some details of a wood fiber wall. Fibril direction is indicated by dash marks. A large fibril angle means wood of low strength.

Figure 4.- Cross section of longleaf pine showing concentric growth while tree remained upright and eccentric growth of wide-ringed compression wood after tree leaned. (Photo courtesy U S Forest Products Laboratory)

ment can prevent the absorption of an adequate amount of preservative into the affected portion of the wood. The unprotected zone is then destined to early failure.

**Strength Properties**

The strength properties of wood are dependent on many factors; some relate to the nature of the wood itself and may arise from differences in species, growth characteristics and moisture content. Other factors relate to the processing or manufacture of the wood; for example, the size and shape of the piece, or the seasoning, conditioning and preservative treatment applied to the product.

It is known that decay and wood-stain fungi can be direct or indirect factors in reducing the strength of wood and the attack of these low forms of plant life must be prevented during pole processing, storage and service.

Strength properties of wood are also affected by heating at high temperatures for prolonged periods of time. The chemical properties of wood cellulose are altered and care must be taken not to exceed safe time-temperature limits during the processing of pole timbers.

Most strength properties of wood increase directly in proportion to the loss of moisture below the fiber saturation point; however, this increase in strength is offset to some degree by a loss of strength due to the minute seasoning checks that develop in wood as it dries. Basic strength values (fiber stress or modulus of rupture in bending) of pole timbers are determined on wet wood – wood in its weakest condition. It has been determined that wood in the above-ground portion of a pole is usually below fiber saturation point; therefore, when poles in service are subjected to loads, they may be expected to withstand stresses higher than basic stresses assigned.

Basic strength values of different species are determined by testing many small clear wood specimens representative of each species. In order to obtain more realistic strength values, strength reducing factors of various defects (knots, spiral grain, checks, and splits) and processing treatments are evaluated by testing many pole-size timbers. Strength reducing factors are combined with basic strength data to give computed fiber stress values. During this conference we shall learn more about this subject in connection with the recently conducted ASTM research program and the new ASA Specifications 05.1-1962. The ASTM test revealed that natural characteristics such as knots, are not important factors affecting the strength of poles unless they are large and located in the lower portion of these timbers.

The specific gravity[1] of wood is one of the most important factors affecting the strength of poles. Other things being equal, a wood that contains more cell-wall substance (primarily cellulose) will be much stronger than a wood that contains less. Wide variations in specific gravity and strength exist among different species, among different individuals within a single species and within a single tree. These variations or differences may be caused by inherited characteristics, environmental growing conditions (soil, rainfall, competition, etc.), the age of the tree, as well as the nature and and position of the wood within the bole of the tree. Through selective tree breeding and certain silvicultural practices, present-day foresters have limited control over some of these factors. Improvement in the quality of timber for poles and other products is possible.

Juvenile wood which develops in the vicinity of the pith of a tree, as well as older wood exhibiting narrow bands of summerwood in conjunction with wide zones of springwood in the same annual ring will be low in specific gravity. Wood of highest specific gravity and strength is located near the base of trees and in the outer portions of stems. This inherent characteristic of localized strength combined with the smooth, straight, uniformily tapered boles, combine to make southern pine trees an ideal material for utility poles. Southern pine is favored as a prime pole-producing timber because of its relatively high specific gravity and strength when compared with other woods. Of the four most important southern pine species, longleaf and slash pines generally exhibit higher specific gravity and strength than do shortleaf and loblolly pine; however, as indicated in Table I, all four species can produce wood of high density and strength. To overcome most of the specific

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[1]Specific gravity is the ratio of the ovendry weight of wood compared to the weight of an equal volume of water.

gravity variation effect on the strength of wood poles, a variability factor is introduced in computing fiber stress values. Visual characteristics are also employed to eliminate poles of very low specific gravity and strength.

**Table I**

**Specific Gravity of Four Southern Pine Species***
**(3997 specimens)**

| Species | Average | Range |
|---|---|---|
| Longleaf pine | 0.54 | 0.36 - 0.85 |
| Slash pine | 0.51 | 0.34 - 0.83 |
| Shortleaf pine | 0.45 | 0.32 - 0.72 |
| Loblolly pine | 0.45 | 0.30 - 0.61 |

* Paul, Benson H. and Diana M. Smith. 1950. Summary on growth in relation to quality of Southern yellow pine. Forest Products Laboratory, Report Number D1751. 19pp.

The rate of growth, or number of rings per inch, and the percentage of dense summerwood in an annual ring are often good visual indicators of specific gravity and strength in southern pine poles. Observations of these qualities can usually be made by extracting small cores of wood from the outer two or three inches of a pole. Southern pine wood produced at a moderate to slow growth rate of six to twenty rings to the inch is generally accepted as having good, average strength. Poles with four to five rings per inch might also be accepted if fifty percent of the rings are summerwood.

Wide rings with high percentages of summerwood should be examined carefully to detect the possible presence of compression wood. Compression wood (Figure 4) is abnormal wood that develops in the lower side of branches and in the leaning trunks of coniferous trees. It is recognized by having a dull, lusterless color; there is little if any color change between the springwood and the summerwood. It is low in strength, it shrinks excessively lengthwise and may give rise to cross-breaks in the outer surface of a pole.

Compression failures in pole timbers should not be confused with cross-breaks caused by compression wood. Compression failures are mechanical failures caused by high winds in a stand of timber, by felling trees over obstacles or by rough handling in loading and unloading poles. Sudden, severe bending causes a buckling of the fibers in a fine line perpendicular to the length of the pole or timber.

## CONCLUSION

The foregoing presentation on the structure and properties of wood, by necessity, has been brief and restricted. In years past, a great deal of attention and study has been given to the characteristics of various woods as related to wood pole utilization. Many published works dealing with this subject are available. The reader is referred to the list of references at the end of this paper if additional information is desired.

It is probable that the future will bring about changes in the requirements for utility poles and in the nature and availability of pole-type timber; if so, additional study of this subject will be required.

In conclusion it can be said, that the stem or bole of a tree - particularly, the southern pine tree - is basically a well designed natural raw material for a utility pole. But for a wood pole to do its best job, we must overcome its shortcomings by developing and applying new and better growing and processing techniques. A knowledge of wood's structure and properties is basic to the attainment of this goal.

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# THE IMPORTANCE OF PROPER POLE HANDLING

By

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## IMPORTANCE OF PROPER POLE HANDLING

In the more than 100 years of modern wood preservation, the wood preserving industry has made great strides in the art of protecting forest products against the ravages of decay, insects, and other wood-destroying organisms.

While some of this progress has been brought about by the introduction of new treating methods and the development of new preservatives for specialized uses, the greatest development has been in timber procuring and handling methods.

The actual manner of treating wood is a relatively simple matter provided proper equipment is available. The Bethell Process (1838) and the Rueping Process (1902) are still the principle methods employed in pressure treating.

Procurement and handling of the timber constitute a major factor in satisfactory timber preservation. It is obvious that no matter how good the treatment may be, the important part of timber preservation is bringing the wood to the treating cylinders in sound condition free from any decay or mechanical damage. Therefore, proper procurement and preliminary processing are of particular importance.

It is the purpose of this paper to present the products, practices, plant methods, and equipment for proper pole handling.

A LARGE PART OF THE SOUTHEASTERN STATES IS IN FORESTS

During the last 20 years land owners have come aware of the value of this renewable natural resource. Many states have adopted Keep Green and Tree Farm programs, and many State Forestry Department, to assure a perpetual supply for future generations, have installed statewide fire protection.

Most of the poles produced in this country are cut from land owned by people other than the pole supplier. Poles are cut from timber owned by the farmer, the large paper companies and the federal government. A pole buyer in contracting to cut poles is required to cut everyting out of the tract that meet specifications. This is most generally defined by the ASA.

Generally the class and length pole that a given tree will make is designated by the woods forester before the tree is felled.

When a tree is felled it is important to remove the bark as soon as possible. As long as the bark remains in place, the tree retains its moisture and, of course, the green wood is subject to attack by decay and insects.

In some operations, peeling of the bark is done in two stages; others in one stage.

In the one stage operation, the tree is delivered to the pole rossing machine with all the bark intact. In the two stage operation, most of the outer bark has been stripped manually from the tree before the tree is delivered to the rosser machine where the inner bark is removed.

The pole rosser has two rapidly rotating cutting heads mounted on arms that rest on the top surface of the pole, as the pole is fed through the machine. The cut of the first head is adjusted so as to take most of the bark from the pole: the second head is adjusted so as to smooth the surface. In the ideal operation only the inner and outer bark is removed.

After the pole is peeled, it moves to classification skids, where it is remeasured, classified and any excess length removed. It is then ready for the next phase, stacking and seasoning.

## SEASONING

Climatic conditions influence air-seasoning. In parts of the South where the rainfall is considerable and the temperature and humidity are relatively high throughout a large part of the year, it is difficult and sometimes practically impossible to thoroughly air season poles before serious injury occurs from decay.

When timber must be air-seasoned under such unfavorable conditions, it is essential that every precaution be taken to regulate the controllable factors so that the most desirable seasoning conditions will be provided.

Winter cutting is best in the Southern States, and the necessity of removing the poles promptly from the woods to proper seasoning yards is greater in the South than were long, cold winters prevail.

Some plant operators apply a fungicide to the surface of the pole by spraying the pole on the outfeed end of the rossing machine.

The primary purpose of fungicide applications is to prevent or retard the development of blue stain or other molds.

While these in themselves do not damage the wood they do act to retard drying. If blue stain can be prevented, the outside one inch of the pole has the opportunity to dry below the fiber saturation point free from attack by decay organisms.

Sprays are effective for a matter of six to eight weeks, and therefore, poles must be watched carefully in the air seasoning stacks.

## DRAINAGE AND METHOD OF PILING

Much of the annual loss of poles ruined or damaged by decay while seasoning or in storage could be prevented through improvement in piling methods. The seasoning yard should be located on dry, well-drained ground where there is good air circulation. Low or filled ground favors the retention of water in the soil, and if surrounded by higher ground it may act as a pocket for the collection of damp air and fog. The location of wood-preserving plants, however, is determined most often by shipping facilities, cost of land, and the like, rather than by the advantages of the site for seasoning. Under such conditions the plant operator must make the best of what is available.

Good pile foundations are essential for efficient air-seasoning. They should be of treated wood or of some other material that does not decay. The foundations should be high enough to keep the bottom course of poles 1½ to 2 feet above the ground, because air circulates downward through a seasoning pile and the moisture-laden air must have freedom to flow out at the bottom. The seasoning piles should be built openly and far enough from each other to allow free circulation.

Poles should not be crowded into a layer but care should be taken to allow two to three inches of air space between poles. Layers of poles in a stack should be separated by pressure treated spacers from 4 to 6 inches thick.

The skids shall be so arranged as to support the poles without noticeable distortion and the height of the piles shall be limited so as to avoid damage to the poles on the lower layers.

Some policy regarding the time lapse between the start of a stack and the completion of the stack should be observed.

The seasoning yard should be kept clean and free from holes where water, waste wood, or debris of any kind may accumulate. Weeds and brush should be kept down not only within the yard but around it. Neglect in these respects retards seasoning, favors decay, and increases the fire hazard.

Because of the difficulty of air seasoning poles in the South, several companies are using mechanical means of drying poles faster. All of these methods are simple modifications in the design and use of lumber dry kilns and they accomplish in days, drying which normally takes many weeks.

## FRAMING AND INSPECTION

Following the seasoning, poles are carried to the framing skids for final manufacture and inspection before treatment. Insofar as is practical, the utilities specifications should provide for complete framing and boring instructions before treatment. Cutting into poles after treatment is very likely to expose untreated wood and thus to permit the entrance of decay or insects beneath the treatment.

Poles are framed to the drawings on an individual basis. The machinery used in framing the poles is generally all electric powered. It is carried from pole to pole to perform a given operation. This is almost mandatory because of the lack of uniformity that exists in framing patterns of various utilities. Were it not for this, pole framing would be done on a line basis and the pole would move through various pieces of fixed equipment on a conveyor system.

Some of the operations that take place while poles are on the framing skids are as follows:

1. **Bark Removal**

Outer bark shall be completely removed from all poles.

On all poles no patch of inner bark more than 1 inch wide shall be left on the pole surface between the butt and 2 feet below the ground line.

On poles that are to be full-lenth treated, no patch of inner bark larger than 1 inch wide and 6 inches long shall be left on the pole surface between the top and 2 feet below the ground line.

**2. Sawing**

All poles shall be neatly sawed at the top (unless otherwise ordered) and at the butt along a plane which shall not be out of square with the axis of the pole by more than 2 inches per foot of diameter of the sawed surface. Beveling at the edge of the sawed butt surface not more than one-twelfth of the butt diameter in width, or an equivalent area unsymmetrically located, is permitted.

**3. Trimming.**

Completely overgrown knots rising more than 1 inch above the pole surface, branch stubs, and partially overgrown knots, shall be trimmed close. Completely overgrown knots less than 1 inch high need not be trimmed. Trimming may be done by shaving machine or by hand.

**4. Framing.**

All poles that are to be given a full-length preservative treatment shall be roofed, gained, and bored in accordance with the terms of the purchase order before treatment.

All gains (mortise or slab type) shall be cut on the face of the pole; and the gained surfaces shall be in approximately parrallel planes.

The poles are now ready to be loaded on tram cars and pushed into the treating cylinder for treatment.

After treatment poles that are to be held in storage awaiting shipments are to be stacked in such a manner as to show no damage or deterioration resulting from poor storage conditions such as contact of the lower poles with the ground or the use of untreated skids. The storage area shall be well drained and shall be kept free of vegetation and debris.

Treated poles shall not be dragged along the ground. Cant hooks, pole tongs, or other tools shall not be applied to the ground line section of any pole.

All poles shipped by rail shall be loaded in accordance with the latest issue of the Rules of the Mechanical Division of the Association of American Railroads governing the loading of commodities on open top cars.

Poles that are to be shipped out on trucks such as transmission poles should be loaded on trucks that will keep to the minimum the overhang on the truck. This will help keep the pole from being broken in transportation.

In closing, I would like to make a final comment concerning the importance of proper pole handling: Poles constitute a large share of a utilities total investment; for this reason huge sums can be lost or saved, depending on the way poles are handled before and after treatment.

# THE TREATING PROCESS
# QUALITY CONTROL PROCEDURES

By

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## THE TREATING PROCESS – STEPS NECESSARY TO OBTAIN GOOD QUALITY POLES

The individual steps of the treating process alone cannot insure the procurement of good quality poles. Treating is but one of a series of major steps whose details must be properly executed if good quality poles are to be obtained.

Figure I is a somewhat simplified and idealized illustration of this series of related steps.

Step I in this series, growing the tree, we still have to leave up to God, although the geneticists claim to be able to give Him some help.

Felling and peeling are rather uncomplicated, but the next step, straightening is more-or-less a sort of black art. Seasoning and treating are very closely related and these are the major steps that will be discussed in detail in this paper.

The next step, delivering, wrapped in cellophane – tied with a red ribbon and backed up by a gold bond insured warranty is in the sales department, which I know nothing about. Serving for 100 years without maintenance is, of course the expectation of the utility or communications company's purchasing agent.

### SEASONING

Seasoning of poles is the process of preparing them for preservative treatment by removal of the water that is present as sap in the living tree so that space will be available into which to inject the preservative. Originally, seasoning was accomplished by stacking the poles in the open and allowing the water to evaporate through the action of the weather. In the seasoning of poles, men have done something about the weather; first, by covering the stacks to protect the poles from rain but leaving them open to the air; and later, by heating the air to accelerate evaporation of moisture. Seasoning of pine poles stacked in the open under normal weather conditions in the south requires several

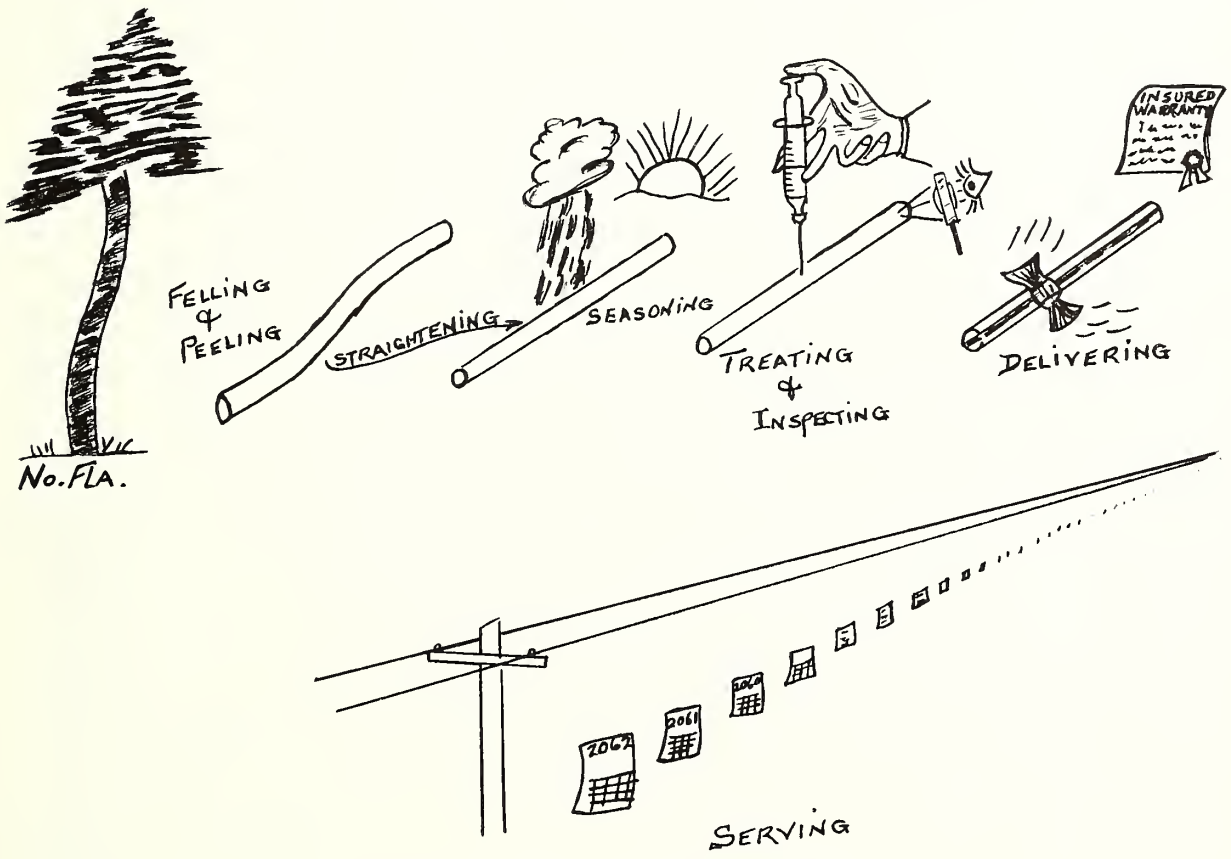


*Figure 1. Steps to Obtain Good Quality Poles*

months, but by circulating heated air through covered stacks of poles, the time required for seasoning has been reduced to one or two weeks. Seasoning in the open through agencies of the weather alone has been designated as air seasoning, while seasoning in covered stacks by means of heated air has come to be known as controlled air seasoning or tunnel drying.

Like any biological material freshly killed, wood is most susceptible to decay during the time when it is stacked for air seasoning, and as a result some decay takes place during this period no matter how well kept, well drained, or how well situated the seasoning yard might be. The degree of damage to the poles because of this decay will, of course, vary depending on the situation of the seasoning yard and its housekeeping. But even under the best of seasoning conditions "mouse ears" and patches of "white kid leather" that are accepted as "yard seasoning" fungi, at times give evidence that the poles are undergoing decay, and although many people regard them as harmless, Richards in 1940(1) showed that these organisms can cause extensive loss in strength of wood.

If poles are to be air seasoned for any length of time in the south, provision should be made to prevent this damage from decay. This may be done by spraying the poles when they are peeled, which should be as soon as possible after cutting, and spraying should continue at intervals during the time they are stored. Aqueous solutions of sodium fluoride, sodium arsenate, and sodium pentachlorophenate alone or mixed with borax are suitable for spraying.

Because spraying in stacks in time consuming and not too efficient from the standpoint of use of chemicals, the practice of pressure pretreatment of the poles in the wood preserving plant is often carried out. Pretreatment can be done with the same preservative that will later be used for the complete treatment of the poles, for example, with creosote, or with any of the aqueous solutions mentioned above. Where the same preservative is being used for pretreatment as for the complete treatment, the treater receives credit for the pretreating chemical if the retention in the final treatment is being determined by testing the treated wood. Otherwise the whole cost of the pretreatment operation must be justified on the basis of savings accruing from prevention of decay.

Protection of large poles, class 3 and above, by spraying or pretreatment should be mandatory if they are to be air seasoned, because they take much longer to dry out properly than do the smaller sizes and are therefore more likely to develop internal decay.

Accelerated air seasoning of pine poles in heated tunnels or kilns is sufficiently rapid so that trouble from decay in this type of seasoning operation is not likely to occur.

A number of methods for preparing poles for preservation can be carried out rapidly enough to permit them to be used in the wood preserving cylinder just prior to preservative impregnation. These are: boiling-in-oil, Boultonizing (boiling-in-oil under vacuum), steaming, and Vapor drying.

Green poles may be dried by placing them in the treating cylinder and submerging them in creosote or petroleum oils containing pentachlorophenol heated to 210 to 220°F which boils the water from them. By impressing a vacuum on the system (the Boulton Process) the water can be removed much more rapidly than by simple boiling-in-oil. Data published by Maclean in 1933(2) on drying southern pine poles by the Boulton process indicate that about 30 hours would be required to dry 35 foot class 5 poles from 100 percent moisture content down to 35 percent. However he was able to obtain fair penetration by drying about half that time. Because a considerable amount of oil is absorbed in the surface of the poles under full cell conditions in Boultonizing, they tend to bleed excessively after treatment, and as a consequence this process is not used on southern pine. The Boulton process is used on the west coast for drying douglas fir.

Steaming wood prior to preservative treatment is a very old procedure but it was not until 1922 that the American Wood Preservers Association appointed a committee to study this process.

In the steaming process, green or even air seasoned wood is subjected to the action of saturated steam at a pressure of 20 psi (corresponding to a temperature of 259°F) for 6 to 15 hours. The steam is then released and a vacuum is impressed on the hot wood which causes some removal of water. Poles having an initial moisture content of 100 percent will, through expulsion of water when the steam is released and evaporation of water during the subsequent vacuum, be reduced to about 75% moisture content. Obviously, the process is not one that accomplishes much drying but through the chemical attack of the high temperature steam, cell membranes that normally impede penetration are broken down or so weakened that preservatives can be successfully injected into the wood. Within

a short time after the appearance of a specification issued in 1936 by the AWPA allowing the steaming of southern pine poles at a temperature of 259°F for 6 to 15 hours, 2 papers were published by Buckman and Rees, showing that steaming for the periods permitted by the specification caused strength reduction of 20 to 25 percent. Little serious attention was given at the time to their estimate of strength losses being incurred in steaming southern pine; but the tests, conducted 1958–'60 in the ASTM Wood Pole Research program brought the facts so forcibly to the attention of pole users that some reduction has been made in the maximum allowable steam temperature in an effort to reduce the strength loss. Recent changes in the AWPA specifications have reduced maximum allowable temperatures for southern pine from 259°F down to 245°F. Aside from causing reduction of strength of the wood, steaming is responsible for most of the corrosion that occurs in creosoting cylinders.

Vapor Drying is a process whereby wood is exposed in wood preserving cylinders to hot vapor, 212 to 300°F, of various hydrocarbons similar to kerosene. The hot vapor condensing on the wood supplies heat to boil the contained water, and it is swept from the cylinder by uncondensed hydrocarbon vapor, to a condenser where the water and hydrocarbon condense and are separated by gravity, the water being discharged, and the hydrocarbon being re-vaporized in the cylinder to boil more water from the wood. Twelve to 15 hours of drying in this vapor will reduce the moisture content of green 35 foot class 5 poles to about 35 percent. After heating in vapor, the poles are subjected to a vacuum to remove condensed hydrocarbon that they have absorbed, and then they are subjected to preservative impregnation.

Comparative tests of vapor dried and steamed poles reported by Hudson (3) showed that the strength of the vapor dried poles was 20 to 25 percent higher than that of the steamed poles.

## PRESERVATIVE IMPREGNATION

Assuming that the poles have been prepared for treatment by any one or a combination of the seasoning processes described; the next step is preservative impregnation. In the discussion that follows only pressure impregnation will be considered since that is the only effective method of treatment suitable for pine poles that has been developed so far.

In order to be able to discuss pressure impregnation of pine poles intelligently, a few simple facts about the anatomy of pine wood are needed. These are illustrated in Figure 2. The left hand sketch, marked (a) in this figure represents in very simplified form a piece of southern pine wood about ¼ inch long and as thick as a match stick. In the sketch the wood has been enlarged about 16 times actual size. Only the longitudinal cells, which make up about 90 percent of the wood of a pine pole, and the ray cells which make up about 7 percent are indicated. The longitudinal cells, or tracheids, run vertically in a tree, and the ray cells horizontally. As indicated in sketch (b) of Figure 2; which is an enlargement of part of a longitudinal cell, and of a ray cell where it crosses it; when wood is impregnated by pressure processes, the preservative in liquid form enters the ray cells, passing from one to another through openings at the ends. Where these ray cells contact a longitudinal cell there are small openings between the two; so that the liquid can flow from the ray cells into the longitudinal cells.

From a physical standpoint only two pressure impregnation processes have ever been used and these are actually the extremes of a single process. All other pressure impregnation processes are but variations between these extremes.

Starting with the Full Cell Process because it was first in use, (1838):

Poles in the wood preserving cylinder are subjected to a vacuum. When vacuum has been established in the wood cells, the cylinder is filled with liquid preservative which flows into the cells when pressure is subsequently applied to the liquid, as indicated in Figure 3. When pressure is released and the change is finished the cells remain more-or-less full of liquid.

In the Empty Cell or Rueping Process (Rueping invented it in 1902):

Poles are first subjected to air pressure which builds up in the wood cells. In Figure 3 the air pressure indicated as an example is 50 psi. The cylinder is then filled with preservative and the liquid pressure is brought to 200 psi. As the liquid enters the cells, it must do so against the air pressure and when the pressure is raised to 200 psi the air contracts as a bubble. When pressure is released the bubble expands forcing out most of the preservative. Use of a final vacuum further ex-

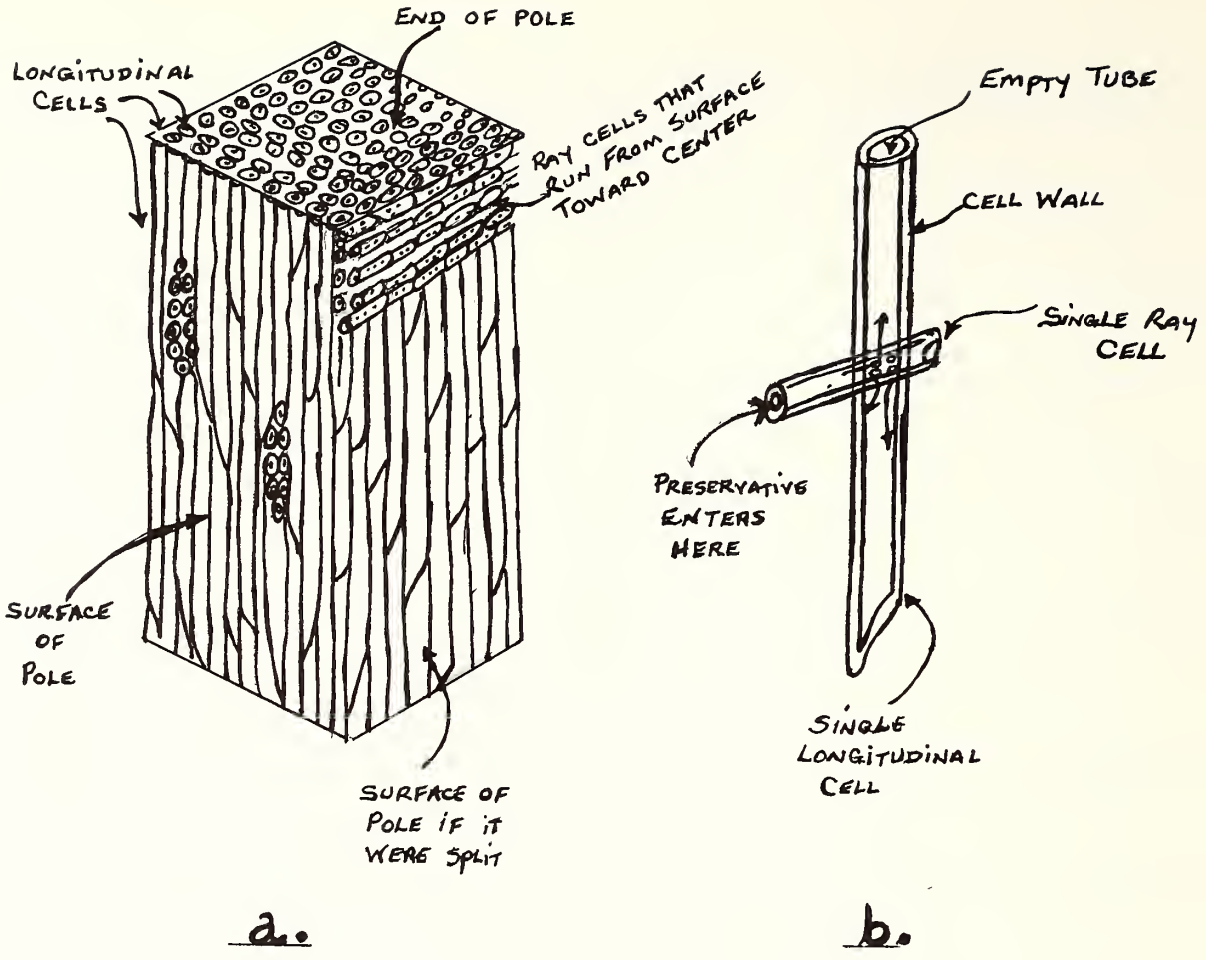


*Figure 2.*

pands the air forcing out more preservative and thus leaving only the cell walls coated.

The Empty Cell Process has entirely supplanted the Full Cell Process for the treatment of poles because of the saving in preservative that can be effected, and because Empty Cell treated poles do not bleed out the excess preservative as do Full Cell treated poles. Therefore their surfaces are freer of objectional tarry deposits if oil type preservatives are being used.

The amount of preservative retained by a pole when using the Full Cell process would be in the neighborhood of 25 lbs/cu. ft. if complete penetration of the sapwood, to a depth of about 3 inches in a 35 foot class 5 pole, were obtained. Equal penetration can be obtained in Empty Cell treated poles with as little as 4 lbs/cu. ft. of preservative.

The Rueping process quickly took over the pole treating field in the period 1925 – 1935 because of the savings in cost of preservative and the desire to have cleaner poles. Average retentions of preservative are easily controlled by varying the applied air pressure, for example: 70 spi air pressure in dry southern pine poles will give a retention of about 8 lbs/cu. ft. of creosote. An initial air pressure of 100 psi will give a retention of about 4 lbs/cu. ft. in these poles.

## RETENTION OF PRESERVATIVE

Up until just recently the amount of creosote retained by a charge of poles has been determined by measuring the volume or weighing the amount of creosote in a treating tank before and after it is used to treat a charge of poles; the difference in these readings being considered as having gone into the poles. Because volume or weight gauges are used to measure the retention in this way, this has come to be known as, "gauge retention".

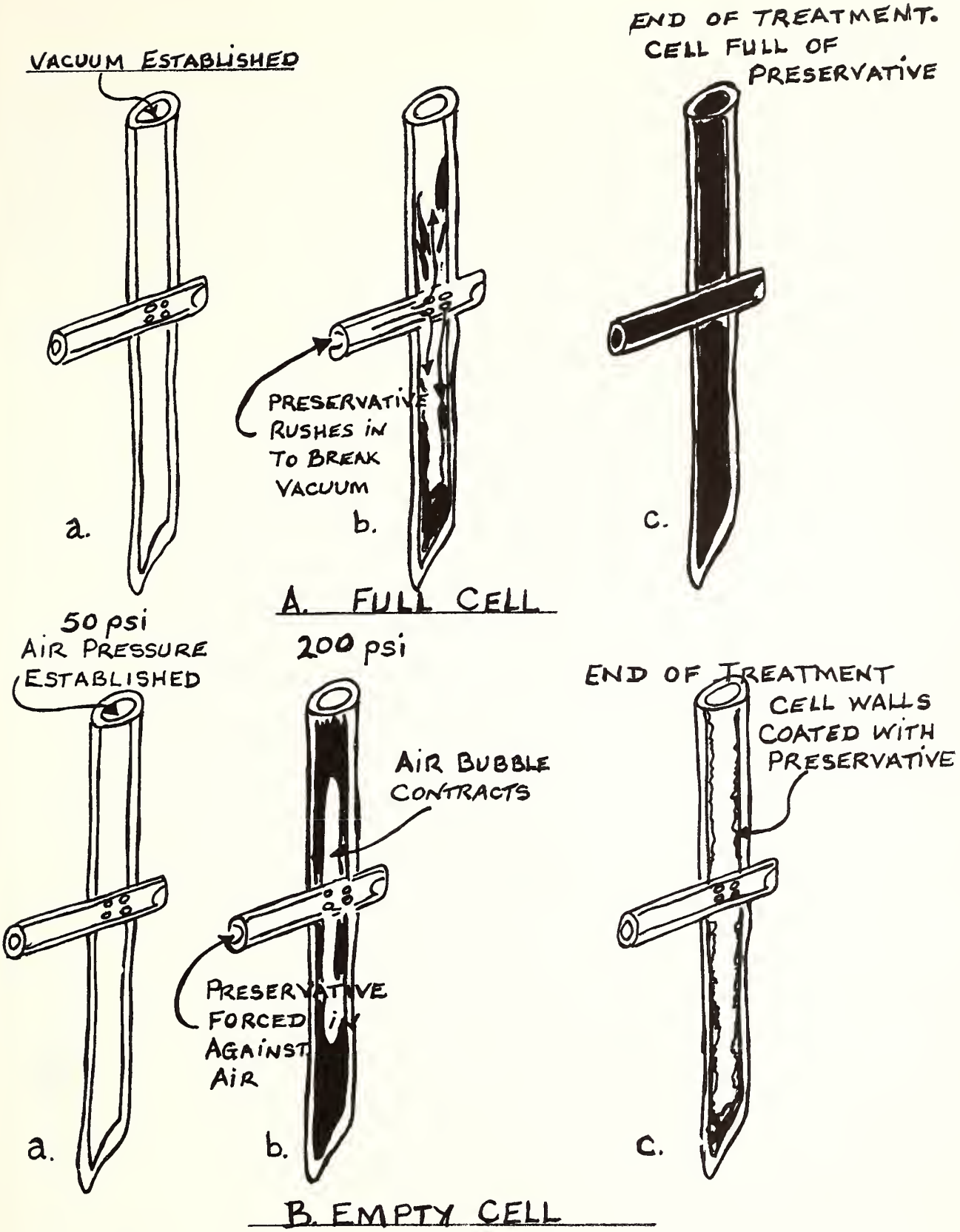


*Figure 3. Types of Treatment*

Lately another means for determining retention has been employed which is called "retention by by assay". For this determination borings are taken from some of the poles in a charge. These are weighed on an analytical balance and then placed in a special apparatus containing a liquid, toluene, which by boiling, extraction, and condensation removes the water and creosote from the borings and separates the water from the creosote. The borings are then freed of toluene by drying, and reweighed. The difference between the first weight and second weight represents the amount of water and creosote that was in the borings. By subtracting from this figure, the amount of water separated, the amount of creosote is found. This amount calculated as pounds per cubic foot is assumed to represent the amount of creosote retained by the charge.

Not to overdo a good thing, the users of southern pine poles wisely went to a retention of 8 lbs/cu. ft. for creosote when they began to purchase empty cell treated poles. They found that they could get at least 2½ inches of sapwood penetrated, or at least 85% of the sapwood depth penetrated on the average with this amount of creosote. They knew also that about 2 inches penetration, which was the average depth that was obtained when poles were treated to a retention of 12 lbs/cu. ft. by the Full Cell Process, was adequate to give good service life. They knew further, from laboratory tests, that about 4 pounds of creosote per cubic foot was sufficient to inhibit the growth of the worst wood destroyers that were known. So they set the requirement at 8 lbs/cu. ft. which represented a good margin of safety. However they oversold themselves on the idea that good penetration was a complete guarantee of good performance of poles in service, and did not pursue the question of adequate retention very closely until they encountered unexpectedly high losses from decay of empty cell treated poles within a few years after they were installed. For the most part these were poles having good penetration and meeting the specifications in other respects. Various explanations were advanced for these "early failures", with the usual outburst of witch hunts.

Creosote producers were blamed for robbing the creosote of its most efficacious fungicidal elements. Wood preserving plants were suspected of shorting the charges of their 8 lbs/cu. ft. of creosote, because they could obtain 100 percent penetration with less preservative. In some cases inspection services were accused of accepting decayed poles for treatment.

Now that the smoke has cleared somewhat we find that the creosote producers have not been removing constituents that have robbed it of its fungicidal activity. But the focusing of attention on the quality of the creosote has brought some much needed revisions of the creosote specification.

Most of the treating plants have been shown to have been delivering an honest 8 pound treatment, because they have been able to meet, with little or no increase in overall inventory use, the new "results type" specifications which require analysis of the treated wood to determine retention.

And the only way in which it could be demonstrated that inspectors were accepting decayed poles for treatment, would be to accept a rigid definition which says that, "containing any decay at all", represents a decayed pole. As pointed out earlier, any air seasoned poles can be shown to contain some decay.

It has become more and more evident that the early failures in 8 pound poles has not been the result of poor quality of the preservative, or questionable treating practices, or poor inspection. If poor quality of preservative or shorting of the quality of preservative were major causes of early failure then the early failures would occur in whole charges of poles, but except for a few rare instances where it can be demonstrated that whole charges of poles showed early failure, early failures occur in a few poles from a charge, the rest giving good service life.

The poles that show early failure will almost always be found to contain much less creosote than their charge mates that give good service life. That being the case, one might be led to try to to find the reason why certain poles lose their creosote quicker than others, because the poles were all treated to 8 lbs/cu. ft. originally.

It is here that the real explanation of early failure of 8 pound poles lies, the early failures are poles treated in 8 pound charges but which did not get their prescribed 8 pounds of creosote.

It will be remembered that in determining the retention in poles, the retention found by gauge was for the whole charge, not for individual poles. The retention "by assay" likewise gives the retention for a group of 20 or more poles. Neither method is directed toward determination of retention in the individual poles. Yet it is individual poles from charges, not charges as a whole, that have

been responsible for most early failures. It would seem then that to get to the seat of the trouble one would merely have to determine not only that the charge as a whole get the required amount of preservative but that the individual poles each get that amount.

This can be done by weighing the poles individually before and after treatment and making necessary corrections for water that might be lost from the poles as a result of the treatment. This operation so far has been too time consuming and expensive for commercial treatments but has been done experimentally. These experimental determinations of retention in individual poles from 8 pound charges have shown unquestionably the reason for early failure of some of the poles.

As an example: Lumsden (3) reported the results obtained by weighing 932 poles treated in charges that had guage retentions of 8 pounds. The weights showed the retentions in individual poles as follows:

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.2 | percent | of | the | poles | had | retentions | less | than | 3 | lbs/cu. | ft. | |
| 9.4 | " | " | " | " | " | " | " | " | 4 | " | " | " |
| 28.4 | " | " | " | " | " | " | " | " | 5 | " | " | " |
| 53.0 | " | " | " | " | " | " | " | " | 6 | " | " | " |
| 73.5 | " | " | " | " | " | " | " | " | 7 | " | " | " |
| | | Etc. | | | | | | | Etc. | | | |

Obviously those poles having retentions below 5 lbs/cu. ft. could not be expected to give satisfactory service in line.

A method for determining the retention of creosote in individual poles has been developed by Hudson (4) (5). This is called the TEST-A-POLE(R) method.

In carrying out retention determinations by this method, borings are obtained from the poles just as is done in inspecting individual poles for penetration; in fact the same borings that are used for determining penetration can be used for the TEST-A-POLE determination of retention. Each boring is ground up with a special high speed grinder that reduces the wood to fiber. The fiber, collected in a test tube, is then treated with a solvent, Dimethylformamide (DMF), which quickly dissolves out the creosote to form a brown colored solution. The color of the solution so formed is then compared with solutions containing known amounts of creosote to determine the amount of creosote present in the borings. The matching of the color can be done by eye or by means of a photoelectric colorimeter.

The results obtained in testing 2474 poles treated to 8 lbs/cu. ft. nominal retention and tested by this method are shown in Figure 4. The figure shows that about 21 percent of the individual poles had retentions of 5 lbs/cu. ft. or less. This agrees fairly well with the results reported by Lumsden for poles that were weighed individually. The data given in Figure 4 for 992 poles treated to 10 lbs/cu. ft. nominal retention show that increasing the retention 2 pounds per cubic foot was effective in reducing the percentage of poles having 5 lbs/cu. ft. or less, but even with the retention that high there still about 6½ percent of the poles having retentions of 5 lbs/cu. ft. or less.

The fact that the data give straight lines when plotted on probability paper shows that the retentions vary according to the law of probability. In other words, if a charge as a whole receives 8 lbs/cu. ft. of creosote, half of the poles in the charge would have less than 8 lbs/cu. ft. and half would have more than 8 lbs/cu. ft. This would mean that if a pole buyer decided that he wanted to require that his poles be tested individually, and set an 8 lbs/cu. ft. minimum, he would automatically reject about 50 percent of the poles in charges that received 8 lbs/cu. ft. by guage. In order to get the 8 lbs/cu. ft. minimum in all of the individual poles, without having too large a percentage of rejects, it would be necessary to increase the nominal retention to around 12 lbs/cu. ft.

In case the pole purchaser desired to retain the 8 lb/cu. ft. figure as the amount of creosote that he wanted to pay for, then he should set up his specification so that poles having retentions of 5 lbs/cu. ft. or more would be accepted provided that the arithmetic average for all of the poles in the charge was at least 6.5 lbs/cu. ft. The 5 pound per cubic foot minimum would insure his not getting any poles with retentions below the threshold for decay, and the charge average of 6.5 lbs/cu. ft. would assure that the poles represented a nominal 8 lb/cu. ft. treatment. If the charge average were below this figure it would indicate a poorly treated charge for nominal 8 lb/cu. ft. retention. To pro-

(R) Trademark registered

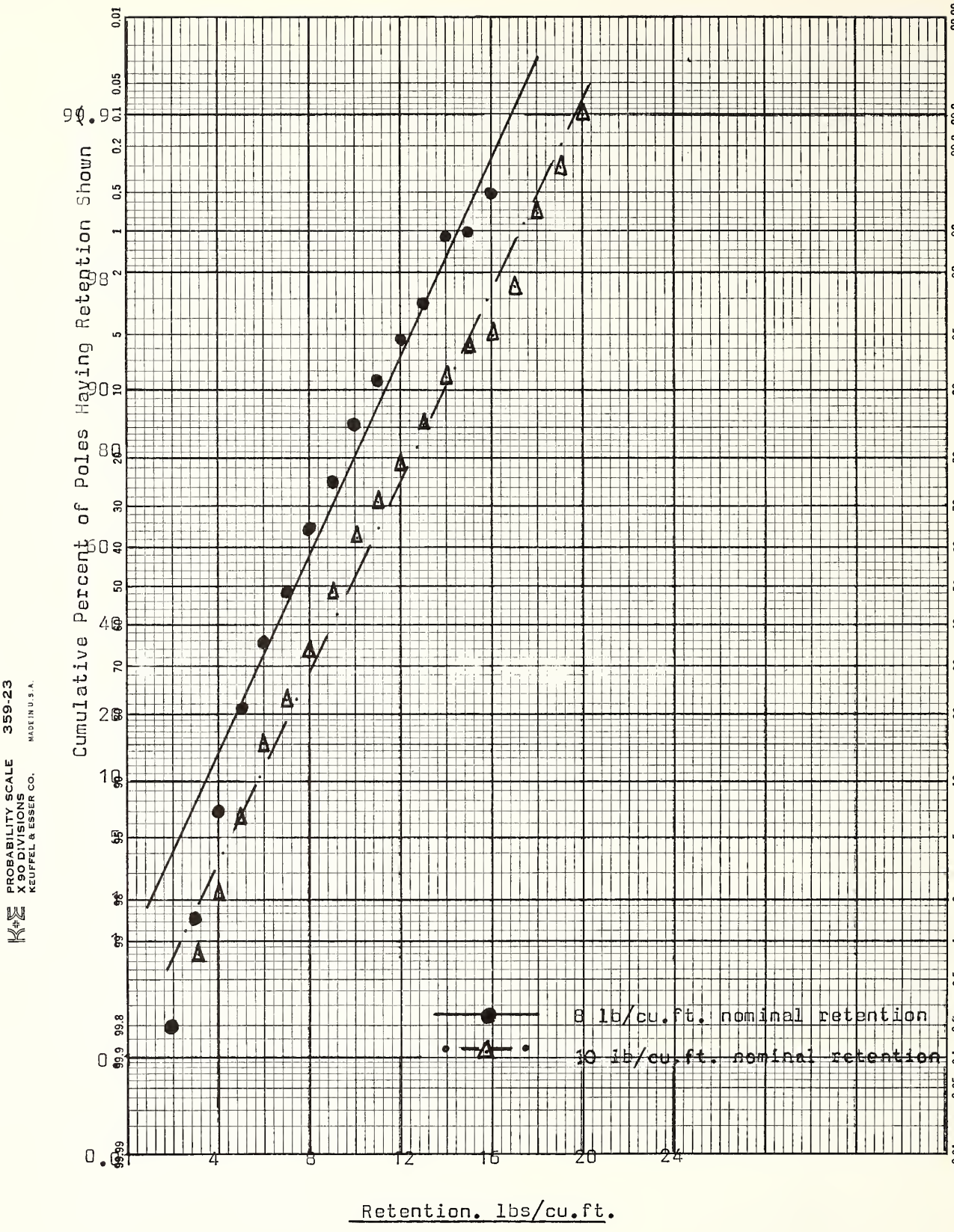


*Figure 4. Retention of Creosote in Individual Southern Pine Poles.*

tect himself against being given a large proportion of poles having retentions on the low side, he would require, that in the event the charge average was less than 6.5 lbs/cu. ft., only those poles having 6.5 lbs/cu. ft. or more would be accepted. This would serve as an incentive to the producer to do better than a mere passing job on the basis of minimum individual retention.

The following limits for retention in individual poles for charges treated to various nominal retentions are recommended:

| | Lbs/cu. ft. | | |
|---|---|---|---|
| **If the retention paid for by the customer is this many:** | 8 | 10 | 12 |
| Retention in individual poles shall not be less than | 5 | 6 | 8 |
| Provided that the average retention for all of the poles in the charge is not less than: | 6.5 | 7.5 | 9.5 |

If the charge average is less than the Figure shown in the last line, then only those poles having the retention given in the last line will be accepted.

Institution of a practice of testing individual poles for retention similar to the individual examination for penetration that has been in use for about 30 years, should be effective in drastically reducing the percentage of early failures of creosoted poles.

## PRESERVATIVES OTHER THAN CREOSOTE

Although the only preservative mentioned so far has been creosote, this does not mean that this is the only one that can be used to obtain good quality poles. Ommission of the others has been made only in the interest of simplicity.

Next to creosote the most widely used preservative for the treatment of poles is pentachlorophenol (Penta) which has been in use since the early thirties. It is a compound composed of phenol (carbolic acid) and chlorine gas, and because of its high toxicity to wood destroying organisms only a relatively small quantity is required to protect the wood, about ½ lb/cu. ft. as compared with 8 lbs/cu. ft. of creosote. In order to distribute so small an amount of this chemical properly in the wood, it is dissolved in a suitable petroleum solvent in a concentration of about 5%, and 6 to 8 lbs/cu. ft. of this solution is used to treat the wood.

Since a combination of creosote and penta has shown higher toxicity than either of the two alone in laboratory and test plot evaluations, some users require treatment of poles with 2% of penta dissolved in creosote.

The treating processes employed for impregnating poles with penta dissolved in either petroleum solvents or creosote are the same as those using creosote alone in conventional treating equipment. However when the penta is dissolved in the very light, liquefied petroleum gas (propane-butane) mixture used in the Cellon (R) process it is necessary to modify the equipment and the treating procedure so that this solution can be used.

Other preservatives that are suitable for the treatment of poles are the water soluble salts like Greensalt, Boliden Salt, and Chemonite which contain copper and arsenic as the active ingredients, with sodium or potassium dichromate in the case of the first two, which acts as a fixative to deposit the active ingredients in the wood in an insoluble form so that they are not easily leached out and lost from the wood.

The constituents of these water soluble salts are dissolved in water to a concentration of about 4% and the solution is injected into the wood by the Full Cell Process.

In this country the AT & T Co. has treated about 50,000 poles with Greensalt; 25,000 of these in 1940 and about the same number around 1950. Not one of these poles has been lost from attack by wood destroying organisms, according to members of the Bell Telephone Laboratories who are responsible for their inspection.

In Canada about a half million poles have been treated with Greensalt, and in Sweden several million poles have been treated with Boliden Salt.

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The principal advantage afforded by use of salt treated poles is that they are much cleaner than poles treated either with creosote or penta-petroleum or penta-creosote solutions. In fact, salt treated poles can be painted. This is also said to be true of poles treated with penta by the Cellon (R) process, since the very volatile solvent quickly evaporates leaving only the crystalline penta in the wood.

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# POLE PERFORMANCE

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## POLE PERFORMANCE

Everyone concerned about wood pole lines would like at times to know more about the condition of the poles and about the circumstances that are determining their useful life.

To electric system managers, poles represent nearly one-third of the total value of an electric distribution system. Better knowledge about them would permit better decisions regarding maintenance and replacement of the poles in line and specifications for the new poles being purchased.

To the REA as a lending agency, poles stand out as an important factor in loan security. Not only do they represent a substantial part of the physical plant securing the loan, but the quality of decisions about inspection, maintenance and replacement can have a considerable effect on financial condition of the borrower.

To the timber industry, and to engineers, performance of the poles in line under all conditions is a final measure of adequacy of the timber, of its conditioning and treatment and of design and maintenance of the lines.

With these needs in mind, REA has been conducting a survey on pole performance, in cooperation with more than 100 electric distribution borrowers throughout the continental United States. The borrowers have furnished details about the poles purchased throughout the history of the system, for installation in the lines. In addition, they have reported details about poles removed or stubbed for any reason since early 1951. This information is the source of the findings that will be discussed in this presentation.

The first major analysis of the data was made during 1960 and included eight years of experience, from April 1951 through March 1959. The second, now in progress, includes almost eleven years of experience, through 1961. Quantities of data included are as follows:

| | 1960 Study | 1963 Study |
|---|---|---|
| Number of participating borrowers | 103 | 125 |
| Poles originally purchased (millions) | 2.85 | 3.6 |
| Poles permanently removed or stubbed for all reasons (thousands) | 38.5 | 155 |

Southern pine is the dominant species in these studies, since it is the most used species. In the 1960 study, three-quarters of the poles purchased and two-thirds of those removed or stubbed were southern pine. Next in order were lodgepole pine representing 10 percent, western cedar 8.8 percent, and Douglas fir 4 percent of pole purchases.

### Variations in Conditions

In looking at the numbers of pole "casualities" due to various causes, the most striking feature is the wide degree of variation between various parts of the United States, and also within geographical areas. Even within an individual electric distribution system, considerable variations often occur. Sometimes this is because of the characteristics of particular groups of poles. However, there are also differences in humidity and soil, and it has been suggested that environmental conditions may vary as widely within an electric system as between the averages of differing geographic areas.

For anyone using results of a study such as this, there is an important need for observing local conditions before depending on experience of others for important management decisions. This introduces a question as to how a manager *can* know very much, at a reasonable cost, about the condition of pole lines spread all over one or several counties. A general study can help by showing what is happening under a wide range of conditions, including some that may be equivalent to those he is concerned with. But a satisfactory answer depends on supplementing these finding with selected spot checks, interpretations of operating and maintenance records and routine observations by line crews.

### Causes of Pole Removal and Stubbing

The major causes of pole removal or stubbing are shown in Table I, along with the locations

along the pole where the damage occurred.

**Table I – Cause of Removal and Location of Damage Distribution for Eight-Year Period All Species and Treatments – All Decay Hazard Regions *(Poles Permanently Removed or Stubbed – April 1951 through March 1959)***

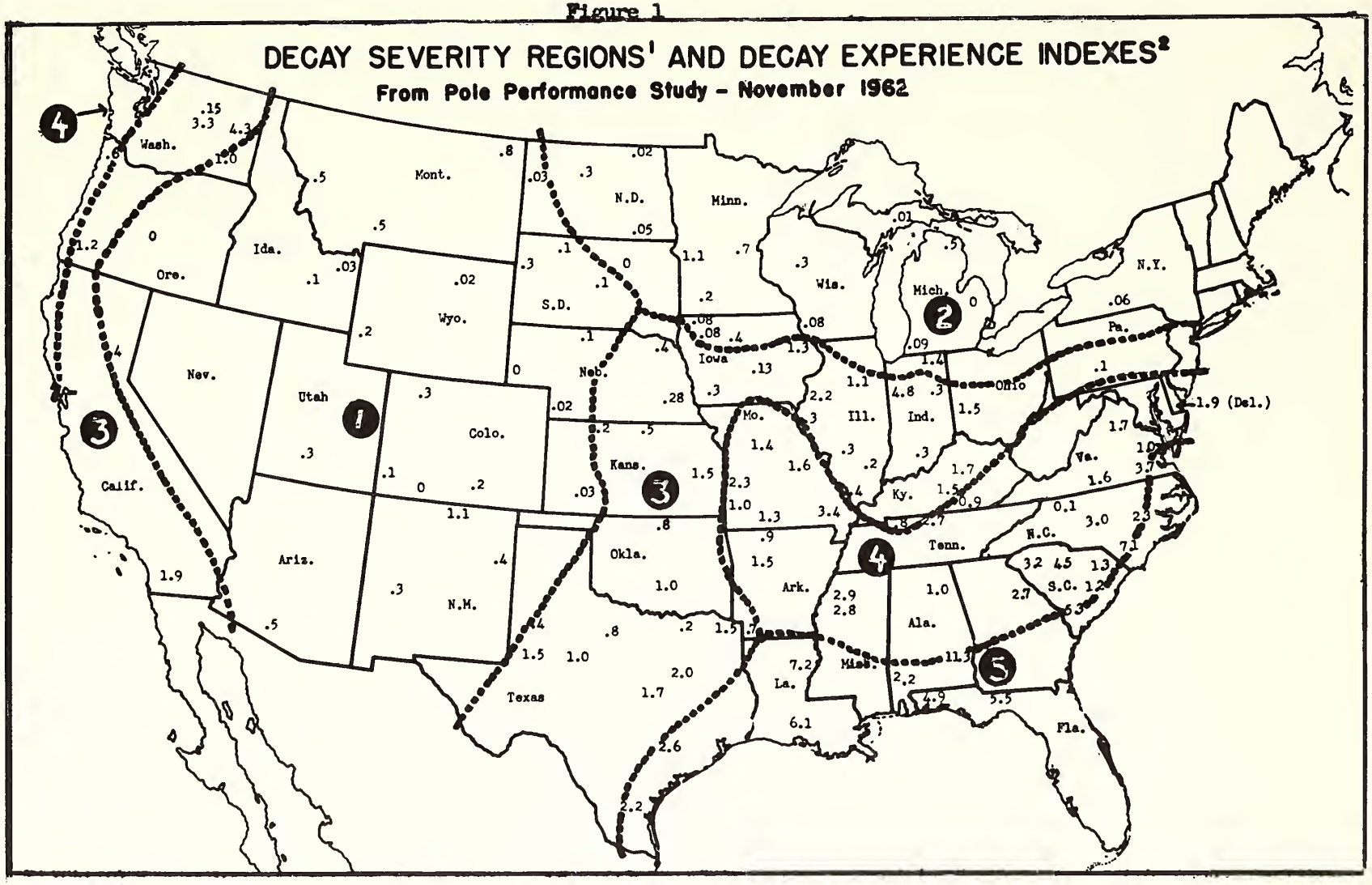
| Cause of Failure | Estimated Distribution by Cause of Removal All | Estimated Distribution by Location of Damage | | | | | |
|---|---|---|---|---|---|---|---|
| | | All | Ground-line and below | Ground-line to 1/4 height | Mid-section 1/4 to 3/4 height | Top 3/4 & up | Entire pole |
| | (pct.) | (pct.) | (pct.) | (pct.) | (pct.) | (pct.) | (pct.) |
| All Causes | 100.0 | 100.0 | 66.0 | 3.6 | 1.4 | 14.8 | 14.2 |
| Decay | 73.4 | 100.0 | 82.5 | 1.6 | .8 | 1.4 | 13.7 |
| Lightning | 7.6 | 100.0 | | 0.1 | 0.5 | 89.4 | 10.0 |
| Woodpeckers | 7.2 | 100.0 | | 0.1 | 4.7 | 79.7 | 15.5 |
| Sleet, frost, snow | 3.7 | 100.0 | 70.2 | 10.1 | 1.7 | 14.5 | 3.5 |
| Wind | 3.0 | 100.0 | 38.5 | 37.3 | 4.0 | 4.8 | 15.4 |
| Mechanical damage | 2.7 | 100.0 | 40.4 | 31.6 | 10.2 | 8.0 | 9.8 |
| Age and obsolete size | 0.9 | -- | -- | -- | -- | -- | -- |
| Miscellaneous | 1.5 | 100.0 | 27.5 | 7.6 | 1.9 | 30.6 | 32.4 |

The various causes vary in importance depending on the location we are talking about. For example, we would expect the severity of decay to be much different in Florida than in Ohio or Montana. Lightning, woodpeckers and various kinds of storm damage vary between geographic areas and also with terrain.

To evaluate some of the effects of climate on decay, the United States has been divided into Decay Severity Regions as shown in Figure 1. These regions were set up initially on the basis of average humidity and temperature during summer months, and adjustments are being made as we gain experience. Most of these adjustments have been in the far west and in Texas, where decay rates evidently were increased because of irrigation or local areas of high humidity; so a shift in the boundaries between regions appeared desirable.

The index numbers on the map express rates of removal due to decay on a scale established by taking the average of Region 3 as 1.00. More or less severe decay conditions are indicated by higher or lower numbers. These numbers are developed mostly from southern pine poles pressure treated with coal tar cresote. The only exceptions are where experience with southern pine was not available. In these instances, pressure treated Douglas fir or butt or full length treated western cedar were utilized as the nearest equivalent. Index numbers for the eastern regions, as developed in the 1963 study, are as follows:

Figure 1




U.S. DEPARTMENT OF AGRICULTURE

Sources: 1. Average summer humidity and temperature (Atlas of Agriculture, 1936) and analyses by the Electric Standards Division, REA
2. Reported decay rates of pressure treated southern pine poles or nearest equivalent species and treatment.

| Region | Decay Severity Index |
|---|---|
| 2 | 0.4 |
| 3 | 1.0 |
| 4 | 2.3 |
| 5 | 6.2 |

Region 1 includes a considerable range of conditions and many species and treatments; so an overall index number for this region is not easily arrived at. The average for this region is expected to be approximately equal to that for Region 2.

The relative importance of each major cause of removals is shown in Table II, for all removals and for each decay region as developed in the 1960 study.

**Table II – Removals* Due to Each Cause During an Eight-Year Period**
**Southern Pine Poles – All Preservatives & By Decay Hazard Region**
***Percent of poles in service – April 1951 through March 1959***

| Cause of Removal | All | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| | pct. | pct. | pct. | pct. | pct. | pct. |
| All Causes | 1.30 | 0.38 | 0.43 | 0.92 | 1.40 | 3.63 |
| Decay | .92 | .22 | .29 | .50 | 1.02 | 3.03 |
| Lightning | .12 | .05 | .07 | .16 | .09 | .13 |
| Woodpeckers | .12 | .01 | .04 | .11 | .13 | .25 |
| Sleet, frost, snow | .02 | .01 | .01 | .04 | .02 | -- |
| Wind | .05 | .06 | .01 | .05 | .06 | .03 |
| Vehicles & machinery | .04 | .02 | .01 | .04 | .05 | .04 |
| Age or obsolescence, no damage mentioned | .01 | -- | -- | -- | .01 | .11 |
| Other | .02 | .01 | -- | .02 | .02 | .04 |
| Number in service,** | 2,167,443 | 140,966 | 232,640 | 826,578 | 723,097 | 244,162 |
| Average age, years | 11.7 | 10.0 | 12.5 | 13.1 | 11.2 | 12.2 |

* Poles permanently removed or stubbed.

* * 103 participating borrowers.

It will be interesting to see the results of the 1963 analysis in comparison to the earlier study, because of the much larger quantity of data now on hand. The updated information for Decay Severity Region 4 is as follows:

**Table III – Removals Due to Each Cause During Eleven-Years**
**Southern Pine Poles – All Preservatives – Region 4**
***Percent of poles in service, 1951 through 1961***

| Cause of Removal | Removals, percent | Distribution |
|---|---|---|
| | | (among causes) |
| All Causes | 5.48 | 100.0 |
| Decay | 1.93 | 35.17 |
| Lightning | .13 | 2.43 |
| Woodpeckers | .22 | 4.03 |
| Sleet, frost, snow | .14 | 2.48 |
| Wind | .09 | 1.65 |
| Vehicles & machinery | .08 | 1.52 |
| No damage mentioned | 2.86 | 52.26 |
| Other | .03 | .46 |
| Number in service 927,092 | | |

An explanation is needed of the large proportion of removals in the category "No damage mentioned" in Table III. Most of these were in the following categories:

1. Poles sold from the yard or from location after line changes.
2. Poles retired during line changes and considered as "not worth yarding" in view of transportation costs, cost of retreatment (ground line or other) and life expectancy.

Following the 1960 analysis a special effort was made to obtain information about poles that might have disappeared from lines and stock without having been reported as "failures" for the Pole Performance Study. This was done so that records would reflect the correct numbers of poles still in service in the lines of participating borrowers to maintain a correct base for expressing the rates of replacement or stubbing due to decay and other causes. As a result, a large quantity of data has been added covering poles disposed of prior to 1960 as well as more recently, under conditions such as those mentioned above.

**Removal Rates As Related to Age**

Trends in removal rates as related to age of poles are being watched very closely, particularly those due to decay. Figures 2 and 3 show the percent removals as related to age for southern pine creosote treated poles in Region 4. The curves in Figures 2 and 3 were developed by what is known as the "moving average" method, in which all poles that were of a particular age, such as 8 years, at some time during the period of record are grouped together to obtain one point for the curve. For example, the poles purchased in the years 1943 through 1953 reached their eighth year of age during the period 1951 through 1961 covered by the present study. The numbers of poles purchased in these years in Region 4, and numbers of removals in the eighth year of age, were as shown in Table IV:

**Table IV – Pole Purchases and Pole Removals by 22 Borrowers Contributing to Experience at Age of Eight-Years**
***Decay Region 4 – Southern Pine, Creosote Treated***

| Year Purchased | Number Purchased | Eighth year of age | Removals in eighth year due to decay | Removals in eighth year due to all causes |
|---|---|---|---|---|
| 1943 | 8,154 | 1951 | 4 | 17 |
| 1944 | 7,396 | 1952 | 4 | 12 |
| 1945 | 19,411 | 1953 | 14 | 30 |
| 1946 | 38,660 | 1954 | 59 | 163 |
| 1947 | 57,398 | 1955 | 31 | 309 |
| 1948 | 70,949 | 1956 | 69 | 430 |
| 1949 | 111,725 | 1957 | 26 | 188 |
| 1950 | 73,600 | 1958 | 14 | 31 |
| 1951 | 59,452 | 1959 | 8 | 31 |
| 1952 | 54,453 | 1960 | 10 | 143 |
| 1953 | 29,290 | 1961 | 21 | 38 |
| **Totals** | 543,488 | | 260 | 1392 |
| Percent removed or stubbed | | | 0.048 | 0.256 |

The poles purchased in 1946, 1947 and 1948 have consistently shown a higher rate of removals at a given age than those purchased in other years. Those purchased in all other years have proven to be nearly enough alike so that they could be grouped together for purposes of the present analysis. Taking these two groups separately, the removal rate for each in the eighth year can be developed from Table IV as follows:

Figure 2

POLES REMOVED OR STUBBED
DUE TO DECAY

SPC Poles -- Region 4

Pole Performance Study - January '63

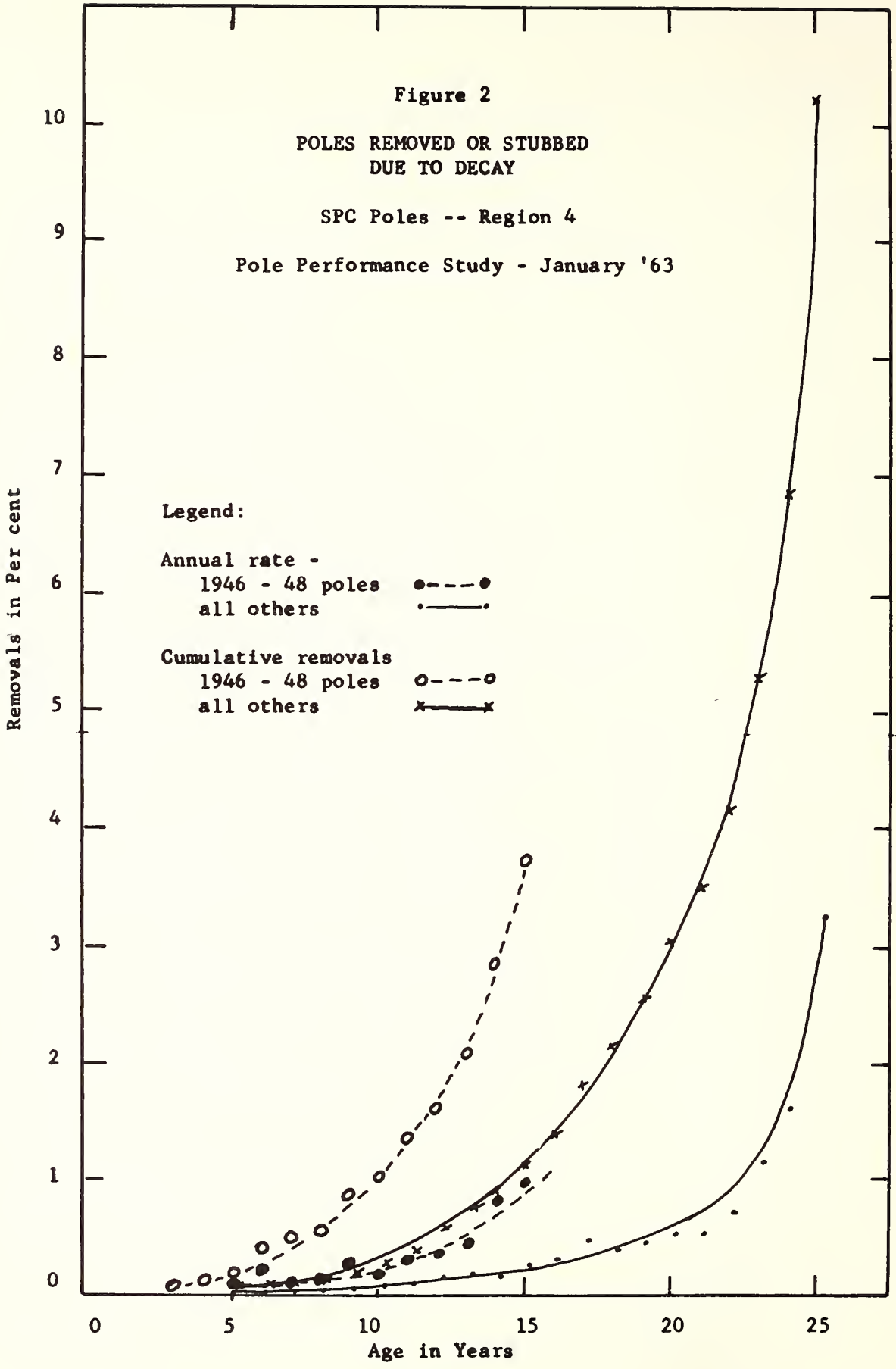
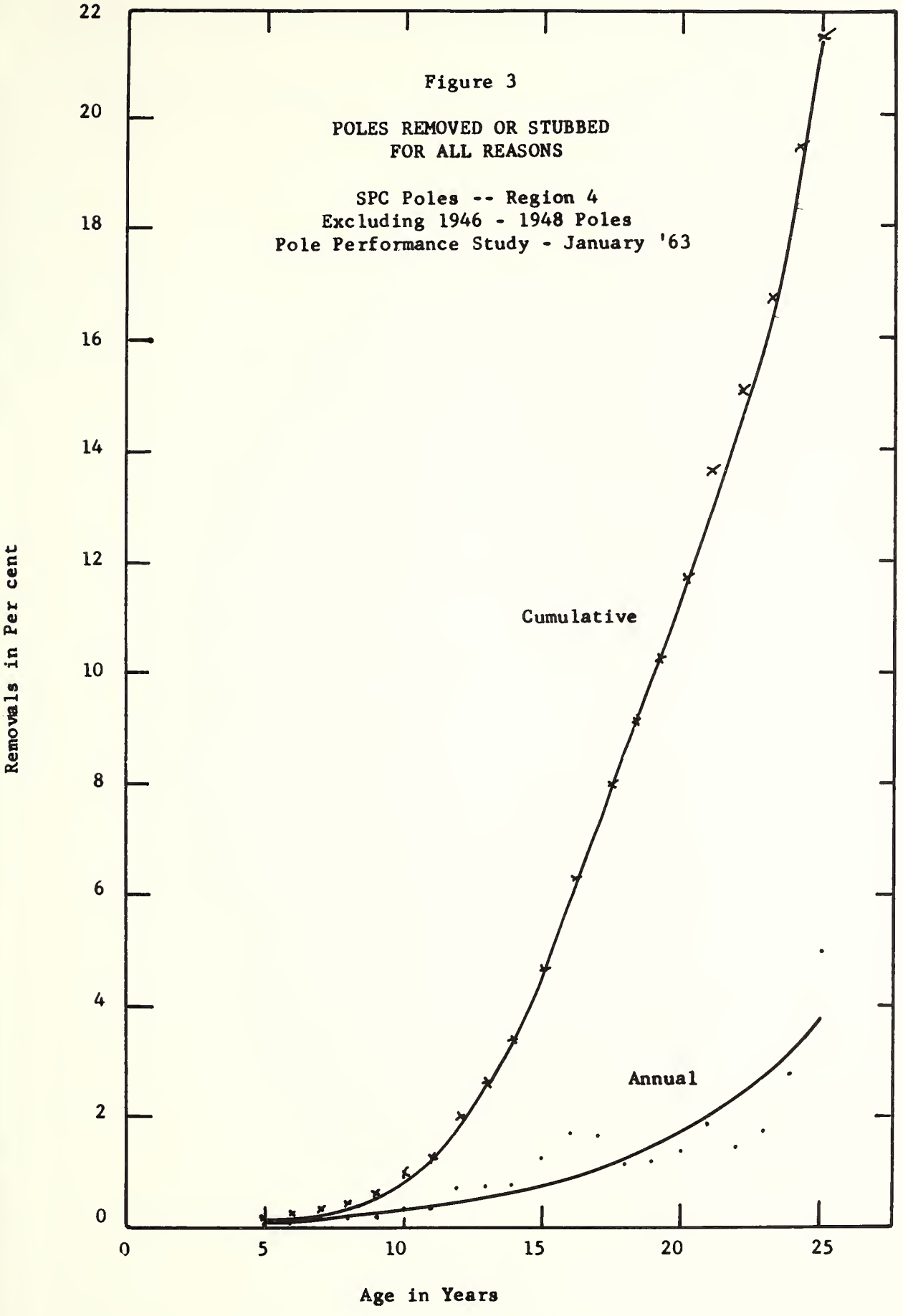


Figure 3

POLES REMOVED OR STUBBED
FOR ALL REASONS

SPC Poles -- Region 4
Excluding 1946 - 1948 Poles
Pole Performance Study - January '63



| Age group | Poles Purchased | Poles removed or stubbed due to | | | |
|---|---|---|---|---|---|
| | | decay | | all causes | |
| | | number | percent | number | percent |
| 1946-48 | 167,007 | 159 | 0.095 | 902 | 0.540 |
| Others | 343,481 | 101 | 0.028 | 490 | 0.135 |

Annual removal rates have been calculated by the moving average method for 1 through 25 years age for Region 4, from removal experience with poles purchased during 1936 through 1960, and are plotted in Figures 2 and 3. The percent cumulative removals, developed from these same annual percentages, are plotted as the upper curves in the same figures.

Further analysis of removal experience in the other decay regions, and for other causes of removal or stubbing, are being continued and will be included in a report for distribution to all borrowers later this year.

# PURCHASING PRACTICE AND PROBLEMS
# of an
# INDEPENDENT TELEPHONE COMPANY

By

C. C. Leiby, Vice President

Florida Telephone Company

Ocala, Florida

## PURCHASING PRACTICE AND PROBLEMS OF AN INDEPENDENT TELEPHONE COMPANY

I have been asked to discuss the "Purchasing Practices and Problems of an Independent Telephone Company" in connection with the purchase of wood products. I have been associated with Florida Telephone Corporation since January 1, 1952, and presently one of my duties is that of Purchasing Agent for materials used in the construction and maintenance of outside plant. Our Company has total assets of approximately $29,000,000; operates in nine counties in Central Florida, serving approximately 40,000 subscribers and 57,600 stations with the most modern telephone service that is available.

In considering the subject which I will discuss briefly, I soon realized that Purchasing Practices and Problems were closely related, since many practices are placed in effect due to problems that have arisen. In purchasing, as we see it, there are three items to be considered; quality, service and cost, and we consider their importance in that order.

We consider the quality of the poles to be most important, for it costs as much to set an inferior pole as it does to set a straight, clean and adequately treated pole. All poles that we purchase must meet American Wood Preservers Association specification and receive a ten pound creosote treatment. Some years ago, our specifications called for eight pound creosote treatment, which we found to be inadequate. In order to assure ourselves that these specifications are met, we require that all poles and cross arms be inspected by the A. W. Williams Inspection Company and approved by them. We have been purchasing poles and cross arms from our present supplier for approximately ten years and we have been well satisfied with the quality of the product furnished us.

Service is our business and service is important in any business. We are particularly fortunate in that our pole and cross arm supplier, the Koppers Company, has a plant in Gainesville, Florida, close to our operating territory. This location enables them to render us excellent service by means of truck delivery to our pole yards, and, when requested, to the job site. We endeavor to inform them as to our annual requirements which enables them to plan their production and maintain a stock for us. As a result, we have, on numerous occasions, ordered poles by telephone one day and they were delivered the next day.

Since their trucks haul a load of approximately 38,000 pounds, we endeavor to meet that amount when ordering a load of poles. Occasionally, we will order a mixed load of poles and cross arms when our pole requirement does not reach 38,000 pounds. We found that it was time consuming to handle each cross arm separately when unloading and stacking them in the pole yard. We discussed this problem with our supplier and we now receive them in bundles of 25, thereby reducing handling time.

Some time ago, we were billed by the inspecting company for the inspection service and billed by the supplier for the poles. We discussed this with them and we now receive one invoice which includes the cost of inspection and the pole, thereby eliminating some clerical work on our part.

The cost of the pole is important, but a low price is costly if the quality is inferior and delivery is not made when promised. As far as price is concerned, we will accept quotations from any supplier; however, our present supplier has been competitive pricewise. We frequently are solicited for a portion of our pole business based on the theory that it is advisable to have more than one source of supply. We have given this consideration, and we find no reason to change our present procedures in connection with the purchase of poles and cross arms.

We receive quality material, excellent service and prices are competitive.

# PURCHASING PRACTICE AND PROBLEMS

# of a

# MUNICIPAL SYSTEM

By

Walter H. Norman, Director of Purchases

Orlando Utilities Commission

Orlando, Florida

## PURCHASING PRACTICE AND PROBLEMS of a MUNICIPAL SYSTEM

The practices and problems of a municipally owned utility should be the same as any other utility, but fortunately or unfortunately as the case may be according to the individual viewing these facts, this is not so.

I speak only from the experience I have acquired in the past 15 years as Director of Purchases of the Orlando Utilities Commission.

The practices and problems run just about parallel – One more or less, bringing on the other. Let's take one practice that my Commission adheres to 100%. "We buy local" – That is, if it is at all possible – We believe that a firm that uses our electricity and water and pays city of Orlando taxes, Orange County taxes, and the State of Florida Taxes – should be the recipient of any profits that are to be made. If we can't find the materials we need locally we do go into the state. At times supplies are unable to be bought in the state and we must go out of the state – but we find that if material can not be found in this country – We don't need it. We buy domestic 100%.

Now for a problem as I have mentioned before we are municipally owned and operated and of course all of these people that use our lights and water and pay city taxes think that they have a right to participate, in our business and they have a perfect right to think so – One little instance that comes to my mind is the one about the printer who came into my office and said that he wanted his share of the business. Now we had some 15 or 20 printers in Orlando at that time – Of course now we have many more but that is another story. I asked this printer what he thought his share of the business was? Of course he didn't know. I told him that I would look into it and let him know on his next visit by. As soon as he had left I called our Billing Department and asked them to get me an average of what various Printers Bills had been per month for the past year. In about 2 hours I had the information that I wanted and after compiling it here is the way it looked – The largest printer in town spent an average of $175.00 per month with us. The next $163.00. The next $148.00 and so on down until we got down to the smaller ones. These ran from $30.00 on down to (and to be exact) $5.30 per month. Guess who the low man was? That is right my friend – The fellow who was complaining.

The following week when he came in I read these figures to him and I said that I thought that I was giving him too much business and maybe I should cut it some. He mumbled something and said "Oh forget it" and stormed out of the office. He never brought it up again.

Another problem we have is in trying to standarize – We know that standardization can save money in many instances, but when bids have to be taken and the lowest bid considered, it is quite difficult to standardize on one make of any piece of equipment. Especially if parts have to be carried for maintenance on the equipment.

There are many, many other problems that I could go into and I'm sure that when the discussion period comes up we will have a lot to thrash out – so until then – Thank you for your attention.

# PURCHASING PRACTICE AND PROBLEMS

# of a

# MAJOR UTILITY

By

R. F. Connolly, Director, Purchasing and Stores

Tampa Electric Company

Tampa, Florida

## PURCHASING PRACTICE AND PROBLEMS OF A MAJOR UTILITY

For me to treat such a broad subject as indicated by this title would take more of my talking and your listening then could ever be mutually agreed upon. However, I will have to bow to vanity and admit that with all the experience I have had in this area, especially Purchasing PROBLEMS, surely by now I am some sort of expert. Why, I've got so many problems that if anything happens to me today, it will be at least two weeks before I can worry about it.

There is one important problem area in purchasing which has consumed a great deal of our time and thought. It, of course, applies to all of purchasing, so I would like to tell you about it generally, and them more specifically as it pertains to wood poles. We have tackled this problem with great gusto, and I believe that the facts you are about to hear will amply bear out our success.

At the beginning of this program in August, 1956, our total supplies inventory was running two million, one hundred ninety thousand dollars ($2,190,000), excluding fuel. Also at that time there were 122,000 customers in our service area. Thus, on a unit basis, we were maintaining $18.00 of inventory per customer. Today, with 170,000 customers, we have only $700,000 total inventory – or, approximately $4.00 of inventory per electric customer. That is, we have reduced our per customer figure by $14.00 – to 33% of what it was in August, 1956.

To apply this same arithmetic to a single stores classification – wood poles – results in similar comparisons and percentages. From an inventory of some quarter of a million dollars in 1956, we have reduced current inventory to $80,000 – again by two-thirds.

Thus, the obvious question – Why have we been spurred on to this new practice? AND – what has it meant to us in dollar savings?

A fundamental factor leading to our revised inventory practices was Rule 88 (amended) of the Florida Sales and Use Tax law. This 3% tax, which is no stranger to many of you, applied to the total cost of all items listed separately on invoices, exclusive of labor. The original Rule 88 stated that during a given six months period, once your sales tax payments to a single vendor totaled $1,000, the balance of your purchases in the remaining time of that same six months period were tax exempt– that is, $1,000 was the maximum amount required by law.

This law was amended by our state Legislature in the 1959 session, and it then read as follows: "Each purchase order shall carry up to the maximum of $1,000 tax". With this change, we could easily have to pay a single vendor for more than the $1000 maximum under previous law. Naturally, we immediately applied this amendment to our operation, and in doing so found that our sales tax costs were subject to an increase of $7,000 per month, or approximately $85,000 per year. Now, you know full well – no business can turn its back on figures like that in hopes that they will just go away. In simple terms, we were faced with either paying the additional tax – and heaven knows we have enough of those to contend with already – or we would have to begin placing blanket orders with our local vendors for a six months period covering specified items and quantities to be released as required. It is a preponderant understatement to say that the latter practice carried the greatest appeal.

The following outline of how we approached and "solved" the problem applies on an overall basis to virtually all of our 54 classifications of stores items. Thus, it applies in lesser dollar amount, but similar percentages, to wood poles specifically.

Our Purchasing Department uses a form with which you are all familiar, I feel sure. It is the repeating, or if you wish, the recurring requisition. Each of these was taken individually and reviewed to determine annual volume of purchases – the minimum and maximum amounts ordered. We found that in quite a few cases we were ordering either too often or in quantities exceeding lead time requirements. Consequently, we are now standardized at 15-day minimums and 30-day maximums.

This was our first step.

We then proceeded to ask our local vendors how they would handle six months blanket orders. Through a process of education of both parties, it was finally agreed that local vendors who were favored with such orders, immediately upon receipt of same, would proceed to stock 120 days usage– and, when this amount was reduced to 60 days, they would then put the remaining 60 days balance

in their stock to complete the six months order. Now, establishing six months requirements involves working with both operating and engineering personnel, which can be no small task in even the best of organizations – which indeed ours is. BUT, believe it or not, this has been accomplished at Tampa Electric Company to the utmost satisfaction of all parties concerned.

The size, type, class, and preservative characteristics of our wood poles are established by a Standards Committee composed of Transmission and Distribution Department engineers. Presently, we use Southern Yellow Pine. We have used a 12 pound creosote treatment, with the exception of penta treated poles for a limited number of street light installations. Recently our specs have been expanded to include creo-penta,* Penta,** *and* creosote.

Order quantity is determined by reviewing the recurring requisition cards mentioned earlier, and by projected needs of engineering jobs that are in the planning stages. After our six months requirements have been determined, requests for quotation are sent out to approved suppliers. Orders are then placed on the basis of price, quality, and service standards. One reason that price is not a single determining factor is that some suppliers consistently offer poles on the low side of the specifications. Also, generally more than one order is written at a time, and it is possible that prices might fluctuate slightly. To help insure our source of supply, orders are divided. We endeavor to place as much business as possible with Florida Industries. At present, our main suppliers are located in Tampa, Live Oak, and Gainesville, Florida. We also place some additional orders in Georgia and Alabama.

At this point I would like to interject an interesting sidelight on the subject of quality control. In past years, we have subscribed to an independent inspection service. This inspection was made in addition to those suppliers normally make during and after processing. Because quality throughout the years continued to meet very high standards, we discontinued the independent service. It is note-worthy that our suppliers are aware of our having given them a "vote of confidence" in this manner, and the quality of our poles has remained at very high levels.

I might also add that we have tried yearly orders as well as the six month ones which I have been emphasizing. Two primary factors lead strong support in favor of the six months order, First, by giving the supplier a six months order, he is able to better schedule his labor to his greatest advantage. He also is able to better forecast *his* supply needs and lead time. Thus,by helping him in these ways, we feel that he is in a position to offer us a better price. Secondly, six months usages are grouped on each successful supplier in order to take advantage of the exceptions allowed under the amended Rule II.

In conjunction with this, Florida law allows cancellation of any items due to defective materials, safety hazards, or failure of the vendor to have items in stock prior to expiration of the order – and there are no other exceptions. If you over-order, tax must be paid on the outstanding balances received during any subsequent six months. So, as you can readily see, it is economically advantageous to figure your requirements as closely as possible.

In addition to the $85,000 sales tax savings ($10,000 with poles alone) – and reducing inventory by two-thirds, we have also cut down our number of purchase orders by about 25%. Furthermore, even, though our customers have increased some 40% since 1956, we have not had to add personnel to our Purchasing Department. Another savings which cannot be overlooked results from better prices for standard items – an amount equal to about 7% overall. With total purchases amounting to $4,673,000 in 1962, excluding transformers, but including all materials needed for transmission and distribution line construction, this 7% figures out to a savings of approximately a quarter of a million dollars.

As you can see by now, we believe that our improved purchasing practices have substantially reduced our operating costs as well as averted, within the provisions of the Sales and Use Tax law, what could have been a drastic tax expenditure. I can also assure you that our vendors are just as pleased about the revised system as we are, for they receive economic benefits which they are able to pass along to us as they gain more of our business – one of those happy "never-ending" circles.

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* Creo-penta: No. 1 creo oil plus 2% penta, pressure treated to 10 lbs/cu. ft.

** Penta: 5% penta treated to 10/lb cu. ft.

# CURRENT ASA STANDARDS

By

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Engineering and Construction

Baltimore Gas and Electric Company

Baltimore, Maryland

## ASA STANDARDS FOR WOOD POLES

While I have been requested to discuss the new ASA Standards for Wood Poles, I wish to expand the scope of my talk to include some of the background and the philosophy that has guided the thinking of those who through the years contributed to the development of standards and specifications for wood poles. First, I will outline very sketchily the history of the progress that has been made. Secondly, the need in 1947 for more precise data on which to base allowable fiber stresses and limitations on defects will be discussed. Thirdly, the development of the program and the actual tests of the ASTM Research Project will be covered very briefly. Lastly, I will discuss the new ASA Standards.

### Engineering Requirements for Poles

Because of their availability, cost, and facility for climbing, wood poles have been the customary support for power and communication overhead lines. In supporting these lines, the poles are subject to vagaries of wind, rain, ice, and snow. Obviously the most important requirement for a wood pole is strength, sufficient strength to hold the lines in the air under all normally anticipated weather conditions. As it is expensive to transfer equipment in replacing a decayed pole, long life is a requisite. Therefore, enough wood must be in a pole to provide adequate strength in spite of possible weakening defects, such as knots; and the wood should be treated with a preservative to insure long life.

Unfortunately for precise engineering design, poles grow as individuals under a variety of growth conditions. Like people, there are no two alike. If poles were manufactured, the preparation of standard specifications for them would be a relatively easy matter. However, the fact that they live and grow must be accepted and specifications have had to proceed on that basis. Of course, the ideal would be to have straight poles without knots, with straight grain and of strong and light wood. Ideally, the wood should be durable and last for years even without treatment. Consequently, in selecting poles, costs and ideals must be compromised. There are certain defects that have such an effect upon strength or life that they should be prohibited. Certain other characteristics, because of their lack of effect, can be permitted under specified conditions. Other defects may be permitted to a limited extent and the limitations included in specifications.

Allowable fiber stress is an essential element in the application of poles to overhead lines. Over the years the determination of the proper allowable fiber stress for the various species of poles has been one of the most difficult and has been the cause of the most controversy. Another requirement for poles, that has been of growing importance, is straightness. For example, if chestnut poles again became available, I doubt that they would be accepted as a line pole. They were anything but straight. Because of the overwhelming economy of overhead construction over underground, utilities have endeavored to improve the appearance of their overhead construction. One factor in appearance is straightness of the poles. To gain long life, some type of preservative treatment is specified.

### Historical

The development of a standard specification for wood poles from the chaos of a number of different specifications, prepared and used by various companies, to a single American Standard has covered many years. The history has been characterized by the gradual evolution from the "guesswork" approach to the collection and application of factual data. In the early days, the allowable fiber stresses were prescribed in the National Electrical Safety Code. Unrelated to the allowable fiber stresses various companies and associations had specifications for poles including the dimensional requirements.

We might consider what has occurred in the allowable fiber stresses. The second edition (1916) of the NESC gave the ultimate fiber stress for chestnut, western red cedar, and southern pine poles as 5000 psi, and for northern white cedar 3600 psi. The third edition (1920) the same values were included with the exception that for southern pine poles meeting the ASTM requirements for dense wood the ultimate stress could be 6500 psi, the other species being unchanged. It should be realized that during that period little data were available relative to the strength of poles. The strength ratings

were low because the engineering of line design had to consider not only a factor of safety but also a factor of ignorance. During that period poles were cheap compared with today's costs. However, in the 1920's as experience and data were gradually accumulated, it began to be recognized that the stress values in the NESC were unrealistic. Moreover, usage of poles was increasing and the prices were rising. The Sectional Committee on Wood Poles (ASA) in 1930 undertook the task of developing an engineered approach to determine allowable fiber stresses.

The Committee collected all of the then available test data on breaking strength of wood poles for northern white cedar, western red ceadr, chestnut, and southern pine poles. It was decided to use a statistical approach. From the weighted average of the moduli of rupture of the poles tested of each of these species the allowable maximum fiber stress was determined by subtracting one-half of the standard deviation. The use of this factor was justified by reason of two considerations:

1. The allowable fiber stress would be used to set the minimum dimension for a given class. While the subtraction of one-half the standard deviation would result in 31 percent of the poles of a given size having less than the target strength, the fact that the ground line circumference would vary between the minimum for a particular class to that of the next higher class, would result in only 15% to 17% of a class being non-conforming.

2. Since loading on poles is considered to be only in quadrature with the line, the average of any three poles would represent the transverse strength of the line. When this and the preceding factor are considered, at least 95 percent of the average of three poles would have a strength greater than the average minus one-half of the standard deviation. Since it would be economically impractical to attempt to attain 100 percent, the two above considerations were followed in setting the following ultimate fiber stresses in ASA Standard 0-5a-1930:

| | |
|---|---|
| Northern White Cedar | 3600 psi |
| Western Red Cedar | 5600 psi |
| Chestnut | 6000 psi |
| Southern Yellow Pine (creosoted) | 7400 psi |

This set the rated fiber stresses but did not resolve the variety of dimensional requirements that existed. As previously stated, there was little correlation between the dimensional requirements for the various classes and the strength of poles. For instance, the same class for two different lengths of poles would not have the same resisting moment. In those days the classes were desingated by letters from AAA to E. Generally the ground line circumferences were based upon the cutback principle. For example, AAA-25's, AA-30's and A-35's all had the same circumference six feet from the butt. This made it possible for the supplier to cut five feet from the top of a 35 foot A pole to make it a 30 foot AA pole. In setting the new dimensional tables the Committee adopted the logical principle that a given class of pole, regardless of length, should be capable of carrying the same load at the top. Such a method of rating would be a great convenience to the designer of the line. To avoid confusion with the previous letter class designations, numbers were used for class designations. The loads applied two feet from the top shown in Table I were adopted. In addition, three classes (8, 9, and 10) were included with only top circumferences specified.

In Fig. 1 an example is given to illustrate the confusing condition using the letter classes that existed. The confusion was even greater than shown because some purchasers had their own dimensioning standards differing from those shown. The numbered classes of the 1931 ASA Standards are also shown. In 1931 separate standards were approved and published for each of the following species: southern pine, chestnut, western red cedar and northern white cedar. Because of their usage, in 1933 standards were developed for lodgepole pine and Douglas fir poles. As less test data existed for these latter two species, the allowable fiber stresses were based upon a combination of pole tests and tests on small clears. The result was somewhat less conservative.

The situation remained unchanged until World War II. The material shortages and transportation problems during the war resulted in the use of other species for poles. In 1945 the OPA requested the ASA to prepare a war standard specification to cover all of the conifers in use at that time.

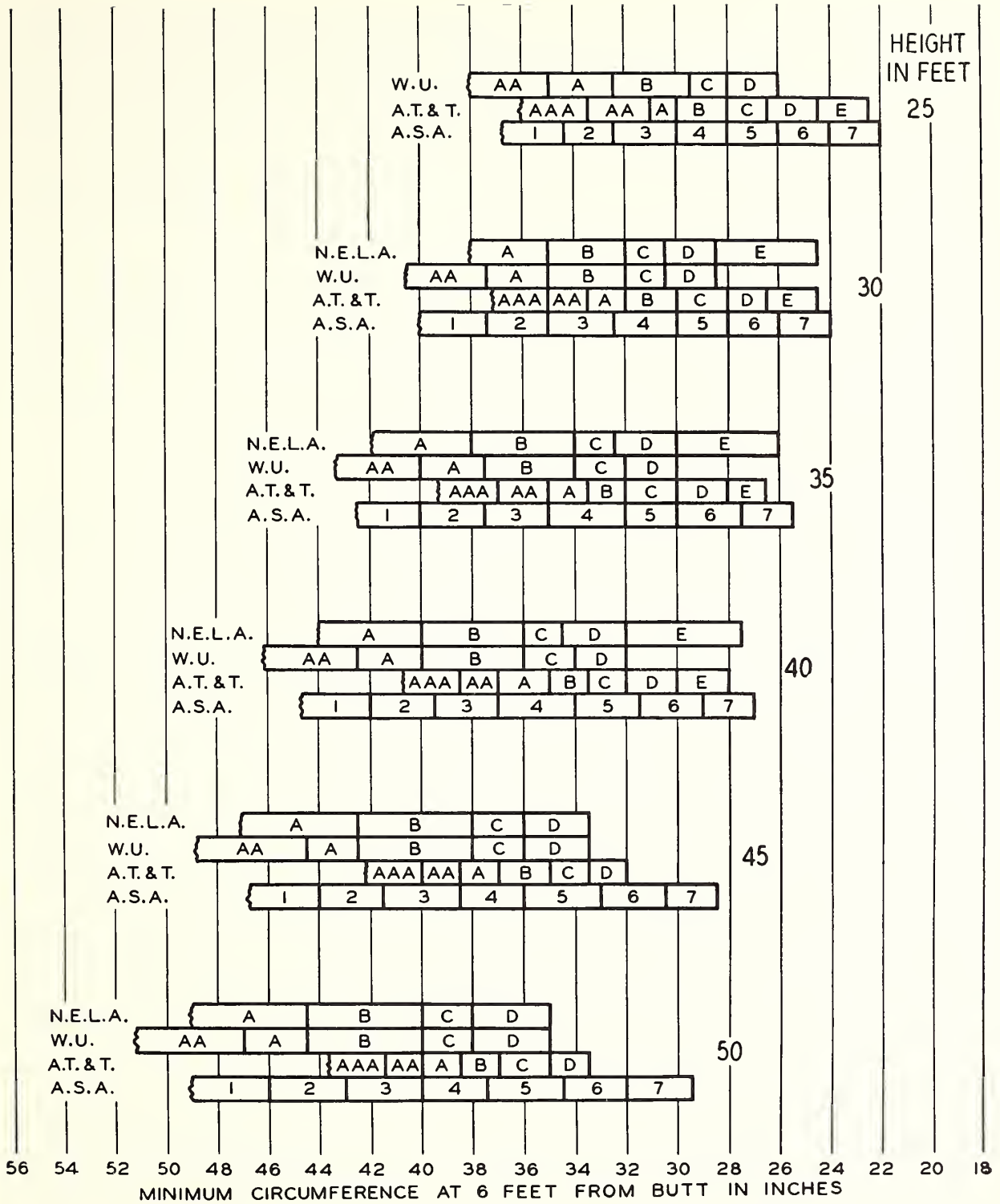


FIG.1 CHART FOR SOUTHERN PINE POLES SHOWING OLD LETTER CLASSES AND 1930 NUMBERED CLASSES.

After the end of the war, a new and revised set of specifications was required. The desirability of including some of the new miscellaneous conifers was evident. Also, instead of having a separate standard for each species, it was believed that it would be preferable to incorporate all species into a single standard. Because of the different bases used in setting the allowable fiber stresses for the 1931 set of standards and for lodgepole pine, a problem existed as to the basis for setting the strengths of the conifers to be added. The results was a compromise in which the old species were left at their previous standard ratings and the newly introduced species were rated on the same basis as lodgepole pine. The new species introduced were: ponderosa pine, western firs (true firs), northern pines (jack and Norway), western hemlock, and western larch. Chestnut poles were deleted. The result was ASA 05.1-1948.

At the time of adopting the 1948 standards, the unreliability of much of the available test data on breaking strength of full-sized poles was recognized. The data were unreliable because the test conditions were not uniform and in many cases not known. Without the method of testing, the rate of application of stress and the moisture content being standard, the test results could not be comparable. At the time the Sectional Committee adopted the 1948 standards, the need for adequate test data was pointed out, and it was recommended that a test program be prepared and implemented.

### ASTM Tests

In response to this need and acting upon the resolution of the ASA Sectional Committee, the American Society for Testing Materials formed a subcommittee on wood poles and crossarms in its Committee D-7 (Wood). As a first step, the subcommittee developed a standard for testing wood poles. This was approved. Then a Task Force was formed in the Subcommittee to prepare a research program for testing wood poles to form a broad basis for rating the strength of poles. The program developed was based upon the following objectives:

1. As there were two standard methods of testing poles (the machine and the cantilever methods), a representative number of poles should be tested by each of the two methods. The objective was to establish a correlation between the two methods.
2. To determine the universality of the test methods for various species and methods of treatment.
3. To check the present values for maximum allowable fiber stresses.
4. To establish a correlation between the moduli of rupture of full size poles and those of matched small clear specimens, both treated and untreated.

The last objective was by far the most important of all. To be able to test a small clear specimen of a pole and correlate its modulus of rupture with that of a full-size pole should accomplish the following:

1. Save considerable cost of testing full-sized poles to determine the strength value of a species not previously tested and to measure the effect of various types of treatment and treating cycles.
2. To provide a means of extrapolating the data obtained on the pole testing program to strength values for the entire population of poles of the species tested and to determine values to prescribe for species not tested.

After a long, trying and difficult fund-raising campaign, work got under way. The test program was conducted at the Forest Products Laboratory under the guidance of a steering committee representing ASTM Committee D-7, Wood. The following species were tested: southern pine, Douglas fir, western red cedar, lodgepole pine, and western larch. To eliminate correction for moisture in large timbers, all poles were soaked in water before testing to insure the effect of the green condition, i.e., well above fiber saturation. Each of the species tested had groups of poles tested untreated and treated to determine the effects of treatment. Realizing that steam conditioning temperatures and times would have some effect upon the strength, treated southern pine poles having had various steaming temperatures for various times were tested. In selecting poles for testing, an attempt was made to secure poles of high, low, and average density. From each pole tested, both treated and untreated, sections were cut to secure small clear specimens which were also tested. In the case of

treated poles, sections were cut before and after treatment to provide small clears to test so that correlations of effect of treatment could be obtained. These data were included in the final report of the test program so that the small clear results could be matched with the test results of the full-size poles. In the report there are much basic data that can and should be the basis of further study in the future. Copies of the final report can be purchased from the ASTM.

**The New ASA Standards**

In developing the new ASA Standards, work in three areas continued concurrently by three subcommittees: Fiber Stress, Pole Classification, and Material Requirements. I will cover each separately. Because I was Chairman of the Fiber Stress Subcommittee, I will cover that in more detail because of my familiarity with its operations.

In preparing the new standards, additional species were included. While they are not now in common use, they were added because it was thought that they are potential pole timber. They are: Englemann Spruce, Sitka Spruce, White Spruce, Redwood, and Alaska Yellow Cedar. Over the years the relative use of the various species has changed materially. Table II shows a comparison between the species treated in 1926 and 1960. A noticeable increase in the use of ponderosa pine, northern pines, and western larch has occurred. In 1926 they represented 0.1 percent of the poles treated. In 1960 they represented 6.3 percent.

Obviously the bulk of the data used in arriving at values for allowable fiber stresses were from the test results of the ASTM program. The committee gave considerable thought to the procedure to be followed in deriving strength ratings for the various species. Early in its work, the committee decided to follow the same statistical approach that was used in preparing the 1931 standards; that is, the principle of taking the weighted average of test results and subtracting one-half of the standard deviation. For ease in use this was converted to a variability factor. Likewise, the use of the allowable fiber stresses for determining the dimensions of poles (circumference six feet from the butt) was continued. Furthermore, as in the 1948 issue, the dimensioning is such that all poles of a given class, irrespective of length, will be capable of withstanding the same transverse load two feet from the top.

The committee faced the problem of extrapolating the ASTM test data obtained for the poles tested of a given species to develop strength ratings that would be representative of the entire population of each species. It was appreciated that the poles tested of a species was a very insignificant percentage of the total population. Also, we had the problem of extending the ASTM data to species not tested on that program. Finally some compensation had to be made for the fact that the ASTM tests were conducted under conditions designed to provide a datum from which allowable fiber stresses for poles in service could be determined. The poles were tested in the green condition. To insure this, they were soaked prior to testing. In the tests of treated poles, the treating cycles followed were generally the most severe permitted by AWPA specifications for each species. As a matter of fact, in the case of the treated pine poles tested there is more than a suspicion that there was some overrun of steaming temperatures. Therefore, we were convinced that poles in service should have strength ratings higher than might be indicated by the ASTM tests. This is not a criticism of the test program, because the test program gives a known and reliable base from which conclusions can be drawn. They form a foundation on which we can build in the future.

Having established reliable data to establish a correlation between the moduli of rupture of a pole and matched small clears, the use of Forest Products Laboratory data on strength tests on small clear specimens should provide a basis for a generalized rating. The Forest Products Laboratory test data was believed to be sufficiently representative of the population of the various species. Studies have shown that the form factor for a beam of circular section, compared with a square beam, is 1.18, based on tests of small clear specimens. That such a factor also exists for poles is evidenced by the ASTM pole test data, but a close evaluation is masked by other factors, including the presence of limited defects. From the ratios of the strength of poles to small clear specimens in the ASTM tests, for the various species, it was decided that a value of 1.08 as a form factor would be proper.

To follow the statistical approach standard deviations were determined. One-half the standard deviation was calculated as a percentage for each species. The average was seven percent. This resulted in a factor or multiplier of 93 percent. As the test data were based upon extremely wet poles with moisture contents well above what would be encountered in service, a correction factor had to be derived for moisture. After study of data collected by the Forest Products Laboratory, the REA and others, a moisture value for the wood at the point where a break due to cantilever load would be expected was determined to be between 15 and 20 percent. From this and previous studies on effect of degree of fiber saturation upon strength a factor of 1.16 was adopted.

By multiplying these three factors together, an overall multiplier of 1.165 results by which the average of moduli of rupture of small clear specimens can be converted to the maximum allowable fiber stress of an untreated pole. However, the effect of treating conditions must be factored into the strength ratings. During the ASTM tests it was found that steam conditioning at 259F for the maximum time permitted had a very substantial effect upon pole timber, causing a loss in strength of 25 percent or more. Because of this, additional tests were made to determine the effect of steaming temperature and time. As a result a limit of 245F was placed upon steaming temperatures. This has been incorporated in AWPA pole treatment specifications. The experience of the Bell System in purchasing poles with the 245F limit indicates that satisfactory penetrations can be secured with this limit. In the case of species treated after air seasoning without steam conditioning, no effect of treatment on strength was observed. For species that were Boultonized, a loss of strength of 10 percent resulted from the treatment. Table III shows the strength reductions that should be applied to untreated poles to obtain the strength after treatment for the various types of treating cycles.

In the new ASA Standards the species are grouped by the type of treatment normal to that species and the appropriate treating factor applied to get the allowable fiber stress. It should be noted that insofar as the standards are concerned the allowable fiber stress is the maximum. These allowable stresses are used in setting the dimensions. However, the NESC recognizes this in the prescribed loading tables which introduce a factor of safety. Table IV shows the allowable fiber stress prescribed in 05.1-1948 and in the new standards. To insure that unduly weak timber is not used for poles, the new standards include a rate of growth requirement of not less than six rings per inch except poles with four or five rings per inch are acceptable if they have more than 50 percent or more summer wood.

It is interesting to note that the allowable fiber stress of several species has been increased. These species account for about 85 to 90 percent of the pole usage. Consequently, appreciable savings should result from the use of the new standards. Moreover, we have confidence in the new fiber stresses for three basic reasons:

1. They are derived from data obtained from tests under controlled standard conditions.
2. By rate of growth limitations fast growing, low density timber is eliminated from poles.
3. Restrictions upon temperatures to which the poles may be subjected during treatment will limit the weakening effect of treating.

The Subcommittee on Pole Classification initially considered the possibility of elimination from the tables sizes and classes whose use were less than one-half of one percent of the total pole usage; the present over 100 lengths and classes could be reduced to about 30. Also, consideration was given to reducing the number of classes by one, making the difference between the allowable transverse loads at the top for adjacent classes 33-1/3 percent instead of 25 percent. One favorable result that might have been obtained from this would be the possibility of discouraging some purchasers from buying only even number classes. However, when further investigation indicated a negligible saving by these changes, it was decided that the confusion that would be introduced would not be justified. In the new Standards dimensions six feet from the butt have been included for Classes 9 and 10. This addition made it possible to include breaking loads two feet from the top for these two classes. They are 740 pounds for Class 9 and 370 pounds for Class 10. Class 8 has been eliminated. The 16, 18, and 22 foot lengths have been deleted from the tables. Except for northern white cedar and Englemann spruce, the tables include lengths up to 125 feet. In all tables preferred lengths and classes are shown. It is hoped that usage of the non-preferred sizes will disappear.

The Material Requirements Subcommittee was charged with covering the areas other than fiber stresses and classification. Its work included the scope, prohibited defects, permitted defects, limited defects, manufacturing requirements, storage and handling, and definitions. Changes were made in various items. I will cover the more significant changes.

Under scope it is clearly stated that the standards cover only poles that are considered as simple cantilever members subject to transverse loads only. This is important because, as I have already stated, the allowable fiber stresses were determined by statistical processes from modulus of rupture data. By subtracting one-half of the standard deviation and assuming that the average dimension would be half-way between the minimum of the ground line circumference for a given class and that of the next higher class and taking the average of three poles in line, we found that less than five percent of the poles would have a fiber stress less than that assigned to the species. However, if we are concerned also with poles loaded as columns, the average of three poles in line cannot be considered. As column loading involves the modulus of elasticity and since the modulus of elasticity data has not been analyzed, definite figures cannot be presented. This point is brought to your attention as a caution to be recognized if very heavy equipment is to be installed on a pole. In the new standards the pole classes and the breaking loads two feet from the top have been included. Also, the species have been listed with their allowable fiber stresses grouped by types of treatment with temperature limitations included. As mentioned before, the density requirements impose limitations on rate of growth.

In the area of limited defects the requirement on depressions containing bark inclusions over two inches in depth has been added. The knot limitations for single knots only have been tightened for the lower half of poles and eased for the upper half. The limitation on shakes has been modified to exclude them from areas within two inches of the surface of the pole. This is more logical than the requirements in the 05.1-1948 standards. Because of the emphasis on appearance of overhead lines, and since many of the individual company specifications have contained exceptions more severe on shape, the requirements for shape have been made somewhat more severe. Ninety percent of the poles 50 feet and shorter and 75 percent of those 55 feet and longer must meet more stringent sweep requirements. The remaining 10 and 25 percent in any lot will be required to conform to the old limitations. This will tend to permit each customer to get his fair share of straight poles. Limitations on splits and checks at the top are now tighter.

**Summary**

What I have said may be summarized briefly in five points:

1. In the early days (prior to 1930), because of the factor of ignorance, wood was wasted due to unrealistic values for allowable fiber stresses. Also the dimensioning requirements presented a chaotic situation.
2. By the statistical approach based upon the then available test data, the factor of ignorance in setting the allowable fiber stresses was reduced and a logical engineered set of dimensioning standards was introduced.
3. The 1948 standards combined the various species into one standard and introduced additional species. While the former allowable stresses were continued, the need for better test data was recognized and the initiation of a program of tests was recommended.
4. The ASTM pole research program provided data from tests under standardized conditions to make available a datum from which allowable fiber stresses for poles in service could be determined.
5. The resulting new Standards, ASA 05.1-1963, increased the allowable stress for four species and introduced five new species. They provide a better set of knot limitations. Also, the new requirements for straightness permit all purchasers to secure their proportionate share of straight poles, which requirements, if generally followed, should not increase the cost of poles.
6. It is believed that the new standards should result in better poles at lower cost.

## Epilogue

The new ASA Standards have been developed from more precise test data and have been pointed toward the needs of the pole user. They should result in the pole purchaser securing better poles at a lower price. It is hoped that the purchasers will secure poles using specifications based upon these standards. By doing this, the lowest cost to the using industries will result. The practice of individual purchasers of imposing special, more severe requirements, and adding exceptions, can only result in an overall increase in the annual bill paid by the using industries for poles. While uneconomical production can become the producers' nightmare, it can also become the consumers' expense.

### TABLE I

Loads Two Feet From the Tops that Poles of the Various Classes Must Withstand
ASA 05.1-1948

| Class | Breaking Load |
|---|---|
| 1 | 4500 # |
| 2 | 3700 # |
| 3 | 3000 # |
| 4 | 2400 # |
| 5 | 1900 # |
| 6 | 1500 # |
| 7 | 1200 # |

### TABLE II

Distribution of Poles Treated in 1926 and 1960 by Species, by Percent of Total Poles Treated

| Species | 1926 | 1960 |
|---|---|---|
| Western Red Cedar | 53.2 | 6.2 |
| Southern Pine | 32.9 | 74.2 |
| Chestnut | 11.9 | 0.0 |
| Douglas Fir | 1.1 | 6.0 |
| Lodgepole Pine | 0.8 | 5.5 |
| Northern White Cedar | - (1) | 1.4 |
| Jack Pine | - (2) | 2.9 |
| Norway Pine | - (2) | 1.8 |
| Ponderosa Pine | - (2) | 0.7 |
| Western Larch | - (2) | 0.9 |
| Other | 0.1 | 0.4 |
| Total Number of Poles | 2,813,130 | 5,647,070 |

1. Northern white cedar poles were not generally treated.
2. Included in 'Other' in 1926.

### TABLE III

Effect of Conditioning and Treating Conditions Upon the Strength of Poles

| Type of Treating Cycle | Precent Reduction in Strength |
|---|---|
| Air seasoned | 0 |
| Boultonized | 10 |
| Steamed below 245F | 15 |
| Steamed above 245F * | 25 |

* Not approved by AWPA Specifications

## TABLE IV

Allowable Fiber Stresses for Various Species

| Species | 05.1-1948 | New ASA Standard Stresses Treatment Group | Stresses |
|---|---|---|---|
| Cedar, Northern White | 3600 psi | A | 4000 psi |
| Spruce, Engelmann * | – | A | 5600 |
| Cedar, Western Red | 5600 | A | 6000 |
| Pine, Ponderosa | 6000 | A | 6000 |
| Firs, Western (true firs)* | 6600 | A | 6600 |
| Pine, Jack | 6600 | A | 6600 |
| Pine, Lodgepole | 6600 | A | 6600 |
| Pine, Red (Norway) | 6600 | A | 6600 |
| Redwood* | – | A | 6600 |
| Spruce, Sitka* | – | A | 6600 |
| Spruce, White* | – | A | 6600 |
| Cedar, Alaska Yellow* | – | A | 7400 |
| Hemlock, Western* | 7400 | A | 7400 |
| Douglas Fir, Interior North | 7400 | A | 8000 |
| Douglas Fir, Coast | 7400 | B | 8000 |
| Larch, Western | 8400 | B | 8400 |
| Pine, Southern | 7400 | S | 8000 |

* Currently not in common use

A – Air seasoned
B – Boultonized – preservative temperature not to exceed 220F
S – Steam-conditioned-temperature not to exceed 245F

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# REALISTIC WOOD POLE SPECIFICATIONS

By

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## REALISTIC WOOD POLE SPECIFICATIONS

It was with a great deal of pleasure that I accepted an invitation to talk to you at this meeting. This is an area which I have chosen as my life's work and so have an intense interest in it. Wood preserving is to me like the preservative treatment given to "most" poles – once you get it in your system – you can't get it out.

Professor Fairing, his associates at the University and the conference board members are to be complimented for their foresight and industry in their efforts to organize this meeting. A well organized program seems simple after it has been accomplished but let me assure you that much hard work has gone into the organization of this program by the committee.

The art of wood treating on this continent is old. As early as March 3, 1752 the *Halifax Gazette* of Halifax, Nova Scotia mentioned that the English Navy was procuring treated wood "to prevent worms eating holes in ships' bottoms".

As for specifications, over a hundred years ago in 1844 Congress granted Samuel Morse $30,000 to build a 40 mile telegraph line between Baltimore and Washington. Morse began by having a lead sheathed cable made. After laying seven (7) miles underground he tested it. He found so many faults with this system that he dug up his cable, stripped off its sheath, bought poles and strung his wires overhead. On February 7th, 1844, Morse inserted the following advertisement in the Washington newspaper: "Sealed proposals will be received by the undersigned for furnishing seven hundred straight and sound chestnut posts with the bark on and of the following dimensions to wit: 'Each post must not be less than eight inches in diameter at the butt and tapering to five or six inches at the top. Six hundred and eighty of said posts to be twenty-four feet in length and twenty of them thirty feet in length.'"

One of the early Bell System lines was the Washington – Norfolk line which was for the most part, square sawn tapered poles of yellow pine probably treated to 12 lbs. full cell or refusal with creosote. Recently while visiting one of our borrowers at Bowling Green, Virginia, I noted some of these poles across the road. They are still in service after more than 60 years and as sound as a prewar dollar. They are so hard, I defy you to put an increment borer into them without mechanical assistance.

Today 80% of our poles are pressure treated southern yellow pine. The remainder are Douglas fir, cedar, larch and some of the western pines. Each user feels his specification is realistic and there is justification for every requirement in it. Much effort has been expended to develop a standardized specification by the American Standards Association and the American Wood Preservers' Association. This is a step in the right direction. However, many users take these standards and amplify them. Some of these are justifiable. New developments arise. Special situations develop. However, some of this appears like the work of non-conformists.

Let us examine the associated facts. Poles are preferred for both power and communications from cost standpoint. For an electrical system, (Detroit-Edison) underground construction is four to eight times as expensive to install than a pole plant. Maintenance is another problem. Wood poles are cheaper initially and require less maintenance than any other possible pole material.

When we see a wood pole in a yard, ready for use, it is a deceptively simple looking object. This might lead us to treat a pole lightly. A combination of familiarity and lack of knowledge might lead one to believe that a pole might be poorly adapted once it assumes its specialized role as a pole. Actually a pole is a section of a tree trunk in nearly its original state. The bark and limbs have been removed from the section and a preservative treatment added. In its natural state a tree must support a cantilever type of loading caused by its crown and the wind load against it. These conditions to which a tree is subjected in nature are similiar to those which affect a pole in service.

The most desired species for poles for many reasons is demonstrated by the fact that 80% of the six (6) million poles produced in this country annually are actually four (4) species of southern yellow pine, namely longleaf, shortleaf, loblolly and slash.

In order to know what we are going to specify let us examine briefly the processes involved.

There are five stages in the preparation of a pole:

1. Selection and cutting
2. Peeling
3. Seasoning
4. Framing and final inspection
5. Treatment

A pole is selected in the woods by a forester or woods boss. This is the first inspection. Naturally he selects a pole of sufficient size and related physical characteristics. He should be reasonably sure that the tree is healthy and when it is finally produced its defects will be within tolerable limits.

The woods crew then fells the tree, lops off the limbs, cuts it approximately to length, and transports it to the plant.

The pole is then peeled. This is usually done on a peeling machine which removes the bark, cambium and a slight amount of sapwood. After the bark is removed the pole is remeasured and classified. Any excess length is trimmed off.

The pole is then seasoned. In southern pine natural seasoning presents difficulties. Southern pine poles are produced in an area of high temperatures, humidity and sources of potential infection. A fungicide is usually sprayed on the poles at the beginning of the seasoning. This reduces susceptibility but does not totally eliminate the danger. Therefore, southern pine poles are usually only partially air seasoned. The poles are usually seasoned for at least three weeks. The sprays are effective for about six weeks. Poles must be watched carefully during seasoning to be sure that they do not become infected.

Seasoning yards have to be properly constructed to allow for proper air circulation. The yard should have adequate drainage, be free from weeds and debris, and have facilities to hold poles off the ground to allow for free air circulation.

Following the seasoning the poles are framed. In many cases this is done on an individual basis. This includes trimming, gaining, boring and branding. This is almost mandatory because of the lack of uniformity that exists in framing between utilities. After framing, an inspection is performed to check for limited defects such as knots, sweeps, defective butts, etc. Other manufacturing requirements can also be checked.

The poles are then treated in a pressure cylinder by the empty cell process. The first step for southern pine is the steam conditioning. This serves a threefold purpose. First of all it sterilizes the wood, secondly completes the seasoning, thirdly it prepares the wood for treatment.

The poles are steamed at 245°F. for varying times depending on the size and condition of the poles. A vacuum is then drawn to remove the excess moisture. The cylinder is then filled with compressed air up to 200 lbs. psi. Some of this pressure penetrates deep into the cells of the wood. The preservative is then introduced into the cylinder without breaking the pressure at about 200°F. This is held for a period of time, the pressure is released and the excess preservative drained off. The air in the wood kicks out the excess preservative. A final vacuum is then drawn to remove excess preservative and clean the surface. A final steaming may also be used to clean the pole surface.

The poles are removed from the cylinder and again inspected. Preservative samples are taken during the treatment. After treatment samples of the wood are taken. Both the oil and the wood are assayed. This determines the quality of the oil, the retention and penetration of preservative in the wood.

All of you are curious to know what I would consider as a "realistic pole specification". Quite frankly I would not consider it appropriate for me to develop a specification. Besides this would be wishful thinking on my part. Rather I would prefer to point out certain facets to you and hope that you will see the reasoning behind them. Standardization has great merit. It facilitates research, production, and procurement. There are several large organizations which have for many years conducted large research programs on poles. If your pole specification is closely aligned with theirs you can take advantage of this research effort. If new things develop you can immediately correlate their findings with your experience.

This may seem one-sided but the small user can also contribute much worth-while data based on field usage if he is alert and objective in his observations. This information is usually developed through various trade organizations such as AWPA, ASA & ASTM. The individual user must be constantly on his toes and must be a good observer. His pole plant represents perhaps a larger percentage of his capital dollar and he must guard this dollar zealously.

Naturally if we have standard poles this will greatly facilitate production. The manufacturer can produce higher, more uniform quality and still keep his costs in line. This will also simplify inventory. If a supplier has a standardized requirement to meet he can smooth out this stocking of poles and can therefore offer better service, facilitating your procurement of poles when you need them.

After we have come this far we need to know precisely what we want to purchase to serve our pole needs. This is the point where a specification's merits enter the picture. The buyer must decide what he wants and needs and so he tells the supplier by means of a specification. A specification is merely a detailed description of the minimum requirements that the buyer needs. Basically it falls into four parts:

1. Strength
2. Dimensions
3. Manufacture
4. Economy

Let us examine these items individually.

**Strength** has been determined by research. The vast majority of the poles are southern yellow pine group of four species of pine classed together. While they have individual differences they are similiar enough to be grouped together. From tests which have been made we know that when produced under certain conditions they will have a specified set of strength characteristics. These basic strength characteristics have been set forth as a result of tests performed by the Forest Products Laboratory for the American Society for Testing and Materials under the auspices of various pole interests. Using this information the American Standards Association has revised its basic specification for poles in the white, i.e. before treatment. This is a composite work, it is sound and I doubt if any organization would gain by repeating this effort for itself.

A specification should therefore clearly indicate the requirements needed to assure the desired product. This can be done by specifying the following:

1. Species of wood and growth limitations
2. Defects
   a. Prohibited – such as cracks, decay holes or hollows
   b. Permitted – such as Red Heart, hollow pith centers and sap stain
   c. Limited – such as abrasions, bark inclusions, compression wood, defective butts, etc.

**Dimensions** are governed by strength and height requirements of the users. The strength requirements are designated by ten class designations, Class 1 being the stoutest – Class 10 the leanest. Dependent on the load, the class is selected. American Standards Association here lists almost 125 choices or combinations. Actually about 25 combinations account for approximately 90% of the poles used. The proposed revision of the American Standards Association's specification indicates the length and class combinations most widely used. I believe these combinations should be specified as standard and all others as optional or special order sizes.

**Manufacture** covers seasoning, framing, branding, treatment, storage and handling. This is the area where most realism is needed. The basic limit should be practicality. However, some users will add other restrictions such as various roofing or top details, special framing and other details which gain them little besides individuality. This individuality costs money because each order has to be handled as such, especially in the before treatment stage. The preservative treatment of poles as covered in American Wood Preservers' Association standards provided for a variety of treatments based on the end use requirements. These standards have been developed by producers and users and are generally feasible for both.

A pole specification can be a detailed step by step type or a performance type or a combination of both. My preference is for the latter. This places responsibility with the supplier for the actual details but allows the user to control certain details he deems important. Experience has shown variations might be needed to fulfill special situations.

One of the most critical phases of manufacture is quality control. This is attained by independent inspection or assumption of responsibility by a manufacturer of known integrity and capability. Each step should be checked and supervised carefully and responsibility clearly assigned.

**Economy** is also of prime importance. Poles must last for a specified time. Maintenance costs must be kept low. Purchase price should not control entirely. Economy only starts with the purchase – it ends with the long-term service received. To be governed by initial price alone can be disastrous. Poles can last for 50 or more years. However, quality has to be paid for initially so that the quality can be put in the pole at the supplier's production facility. A quality pole is the cheapest in the long run. A specification should require that the producer use techniques which assure that properly treated poles will result. For this, a fair price naturally must be paid.

I have referred to American Standards Association and American Wood Preservers' Association standards frequently. Why not then simply specify that poles shall be produced in accordance with the appropriate Association's standards? Basically this would be ideal. However, there are changes in the art of wood preservation and in the demands which are placed on poles. National associations must be conservative and extremely careful that their standards are correct. They therefore have procedures which must be followed in developing their standards. Thus a standard may be many years in the formative stage. An alert pole buyer can many times foresee a trend and by a small modification of his specification can take advantage of these developments earlier than otherwise.

The REA specification is basically a combination of the ASA and AWPA standards. To these standards we have added provisions to govern inspection, quality control and other administrative details. We have also defined the options we desire when such are allowed in standards and have set forth the end results which we expect. We have divided the country into five (5) areas of use and have provided for heavier treatments in areas where decay is more severe. We regard these as reasonable variations which are based on experience.

What can be done to attain a reasonable and realistic pole specification? First of all I would encourage investigation of the current standards available. These are based on wide experience. Secondly, participate in association meetings and discussions. Your experience is needed. You will also learn of valuable research which will be of benefit in the future. Many times the actual user can help the research scientist on practical problems and observations.

In conclusion I would encourage each of the users present to learn as much as they can about their poles. If possible, visit a treating plant and learn the operation. Compare your poles with others. Perhaps you are requiring a frill which is costing you money and gaining you little. Establish a program of destination inspection. Spot check your poles when you receive them. Remember, any specification lists only the minimum requirements expected. All poles should not just *meet* these minimums. The majority should exceed them in quality, workmanship, class and treatment. Occasionally you will find more variation than normal. Determine the reasons and then act accordingly. If you find a better method, don't hide light under a bushel. However, let's try to avoid frills but rather endeavor to be practical and reasonable.

# RECENT CHANGES IN NES CODE

By

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## RECENT CHANGES IN NES CODE

Last year, shortly after the 6th edition of the National Electrical Safety Code became available, I was asked to discuss some of the changes with your committee. At that time interest in the Code revision was rather keen because most of us knew very little that was going on in connection with the work itself, and many looked forward to changes perhaps with just a tinge of selfishness – or putting it another way – looking forward to the changes with the idea of benefiting in one way or another from the standpoint of our individual interests. In your case I would assume that the conservation of timber would be of primary interest, and I will go so far as to say that the desire to conserve pole space was perhaps foremost in the minds of all users of timber for this particular purpose.

As most of you know I am with the Telephone Company, and we use a few poles too – and we want to conserve timber. My job, or one of my jobs over a period of years has had to do with the coordination of power and communication facilities – i.e. electrically, and as time has passed and we utility people have become more closely allied, structural coordination, joint use, etc. has become increasingly important. With this, the matter of clearance, separation, and perhaps more important – safety have attracted my attention and have been of primary interest to me. Therefore, my discussion will be devoted largely to these items with which I am most familiar, rather than to Code changes generally. Safety is everybody's business so with this in mind I cannot go far wrong in discussing even a work that is as delicate and involved as the National Electrical Safety Code.

It has been about twenty years since the Fifth Edition of the Code was published. During that period, we have seen tremendous growth in both the power and telephone industry. This unprecedented demand for electric power and telephone service, coupled with inflation has forced us all to look for better and less expensive ways of doing a better quality job.

We have seen distribution systems changing from delta to grounded wye; voltages increasing from 2400 to 7600 to 14,000 and even 20,000. Maximum transmission line voltages have doubled – and this is apparently not the limit. You have seen the telephone industry pretty generally erase the 5000 volt limit for joint use. We now have joint use at almost any standard voltage you can name up to and including some few cases at 138 KV. The telephone industry was just beginning to go to long span construction in 1940. Now it is commonplace. The recent development of multiple line wire has almost eliminated new open wire construction in the telephone industry. Plastic sheath cable is replacing lead cable. The use of pole mounted capacitors has become commonplace. We are all aware, I think, of these developments, and many others which I shall not take the time to mention.

I realize these items are not unknown to you, but I would make the point that many changes have taken place in our respective arts during the past twenty years. These changes, coupled with factors of a social and economical nature, generated pressure to make changes in the Safety Code. We would rightly expect the Sixth Edition of the Code to reflect at least some of these things.

Despite the fact this revision job took ten years, I suspect that most of the people who worked on the new Code are somewhat disappointed, and now that you have reviewed it you probably feel the same way. The Sixth Edition, like its predecessor the Fifth Edition, is a compromise, which fact probably comes as a surprise to nobody. Although no industry or group got everything they wanted, the changes are none the less, substantial to both the power and the telephone industries without sacrificing safety.

With this background in mind, let us briefly examine some of the changes in clearances.

First and most far reaching in its effects, is the change in definition of voltage. Circuit voltage of effectively grounded circuits is now defined as *voltage-to-ground instead of voltage between wires.* This will be particularly significant for 7600V multigrounded wye systems since the circuit voltage becomes 7600V instead of 13,200 and the limit for 40 inch conductor clearance is 8700 volts. As shown in Figure 1, this will permit a 20 inch reduction in clearance between primary conductors and telephone facilities or a reduction of two feet in crossarm spacing if both power and telephone facilities are on crossarms. Presumably there is no change in the treatment of delta connected circuits not effectively grounded is still the highest voltage between any two conductors.

We note the same change in separation between three phase 7600 volt-to-ground wye primaries

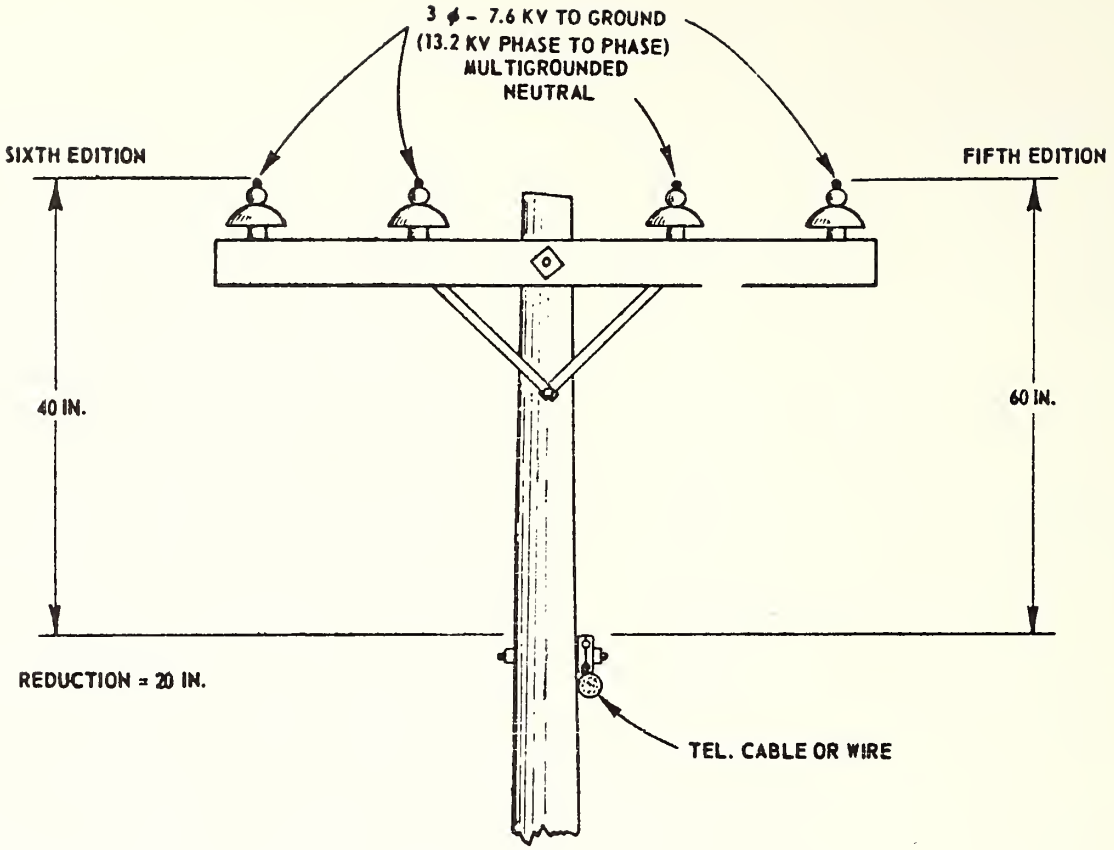



FIG. 1

and 115/230 volt secondaries (and for the same reason). (See Figure 2.) I have shown secondary conductors on a crossarm; the same clearance of course, applies if they are on a rack. Both of these items are going to help conserve pole timber and reduce pole costs. These changes simply eliminate the inconsistency between clearances for single phase and three phase construction. As you know, for years the Joint Pole Practices (M-12) permitted the reduced clearances I have shown only for single phase construction. This was on the basis that voltage between conductors of a grounded system was considered to be the highest voltage present between any two conductors *at the location in question.*

You may recall Part 5 of the Joint Pole Practices was issued as a separaee item for field trial shortly after M-12 was released. Part 5 of course, deals with special clearances for long span joint construction. The experience gained with these rules was deemed satisfactory enough to warrant including them in the new Code. They were, of course, designed to provide greater safety for long span joint construction, as wire flip-ups had become tragically common. The "line-of-sight" and "line-of-sight plus 30 inches" rules are illustrated in Figures 3 and 4 respectively. As you undoubtedly know from your own experience, these requirements do occasionally mean separations at the pole which are somewhat larger than Fifth Edition requirements.

Currently, our use of some extremely small sag facilities such as lightweight (.2 lb./ft.) cable on 6M strand, coupled with the use of certain large sag electrical facilities such as high conductivity all aluminum stranded wire can easily produce situations where "line-of-sight" clearance alone may result in 15-16 inches clearance in mid span. The 30 inches in midspan rule would control in such a case. Fortunately, there are a number of power conductors available which are characterized by relatively small sags.

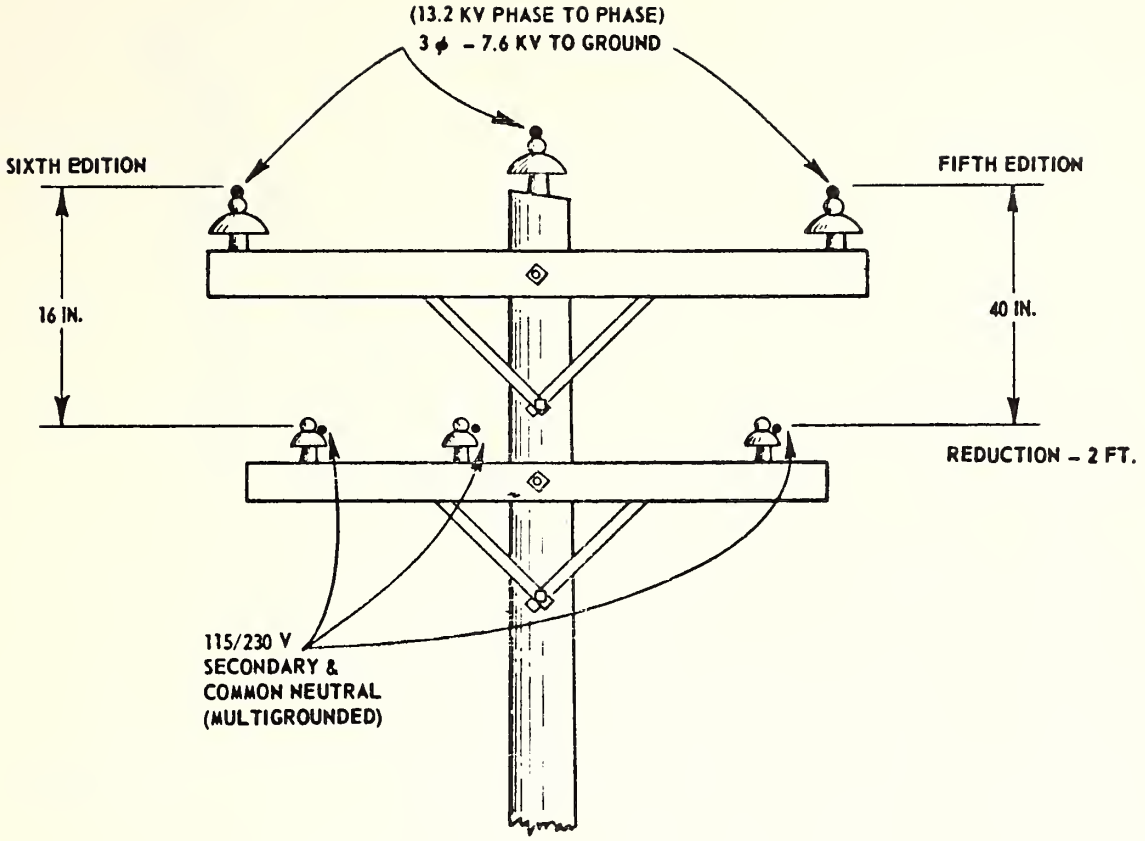


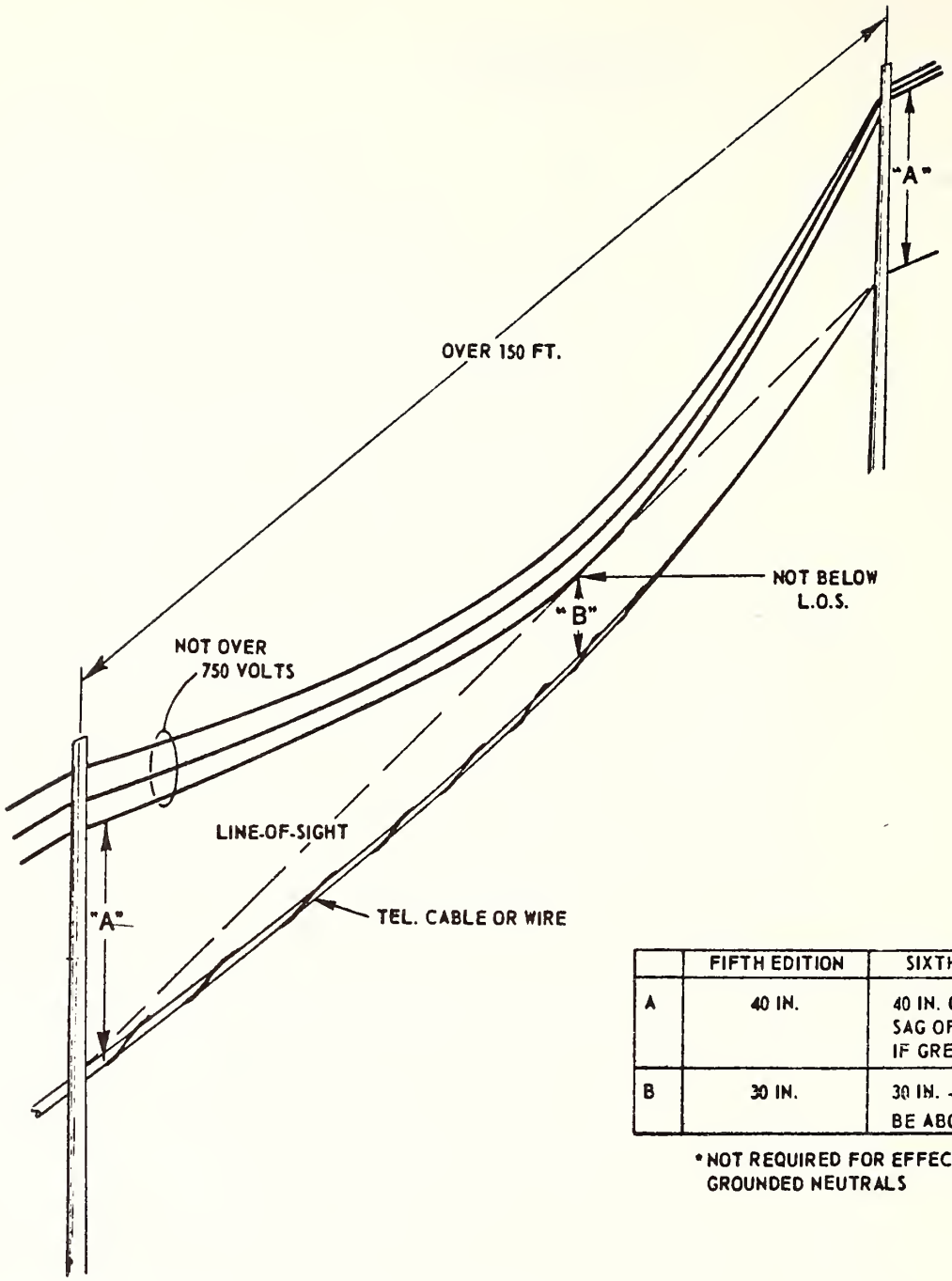

FIG. 2

Let's take a look at some of the other clearances on joint poles. The separation between telephone Facilities and electric equipment such as transformers, voltage regulators and capacitors is probably as good a one to start with as any other. As Figure 5 shows, the *minimum* separation has been reduced to 30 inches. This applies only if the case or tank of the equipment in question is effectively grounded as a uniform practice over a well defined area. The reduction was based on the premise that while effectively grounded facilities do not represent an electrical hazard, there is still a need for head room, and space to erect aerial tents etc. The qualification as to uniform practice over a well defined area was made to avoid administrative difficulties, i.e., telephone personnel can hardly be expected to distinguish between effectively grounded and non-grounded equipment in individual cases.

You may have noticed that most of the changes mentioned thus far have been in the form of reduced requirements. Here is another exception. The separation between ungrounded streetlight fixtures and telephone cable has been increased from 12 inches to 20 inches as shown in Figure 6. Note this may be reduced to four inches if the fixture is effectively grounded. Also a clearance requirement (12 inches) for exposed drip loops has been established. There was no requirement in the Fifth Edition.

Our bad electric shock experience with energized light fixtures indicated a need for greater clearance in this case. We hope this will help. However, we believe that grounding the fixtures will contribute more towards safer working conditions than this small increase in clearance.

Before leaving the subject of joint use clearances, it would seem worth while to mention a special provision for joint, or common crossing poles. This new rule permits telephone service drops to be attached within four inches of effectively grounded neutrals on common crossing poles, if the



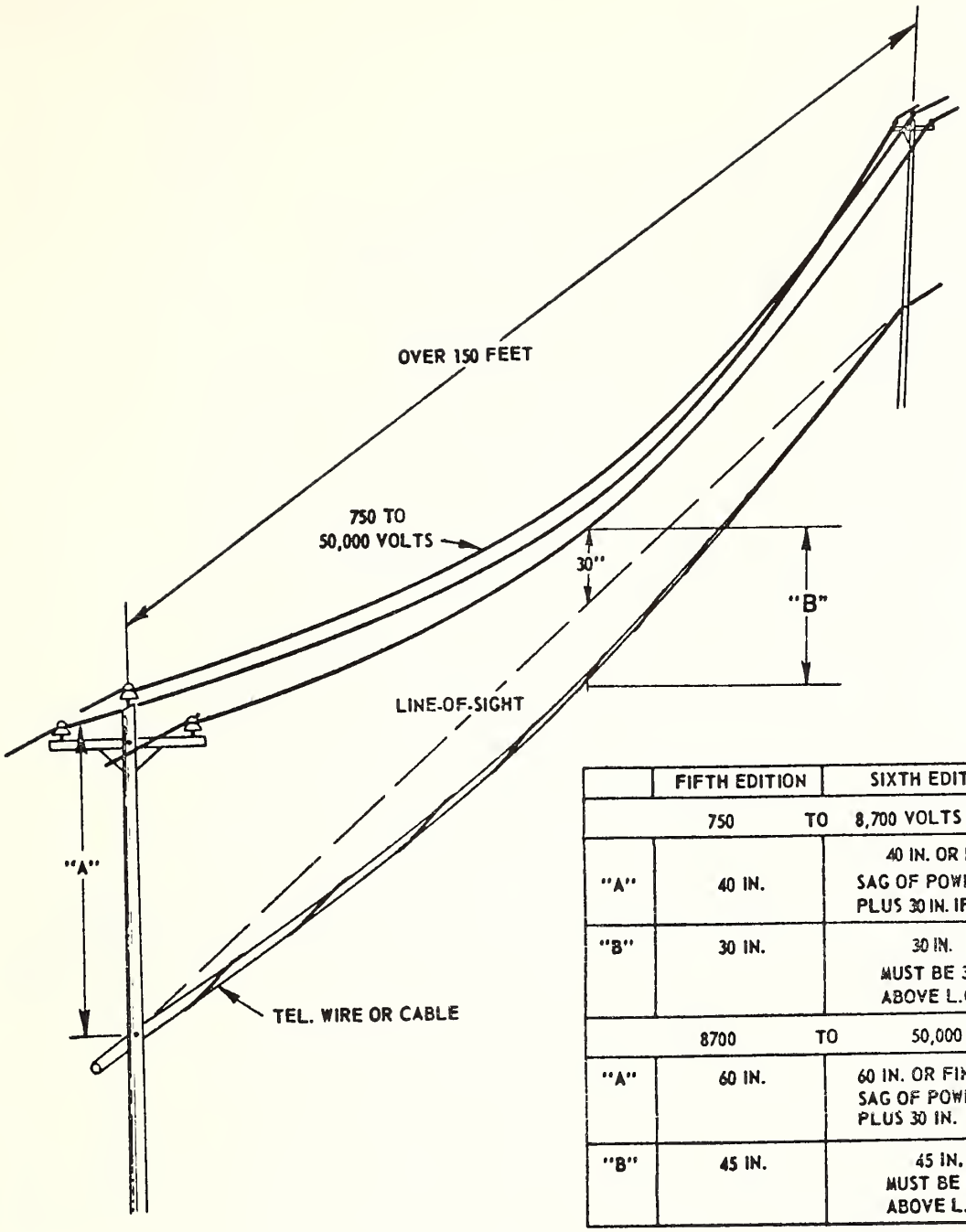

| | FIFTH EDITION | SIXTH EDITION |
|---|---|---|
| A | 40 IN. | 40 IN. OR FINAL* SAG OF POWER WIRE IF GREATER. |
| B | 30 IN. | 30 IN. – ALSO MUST BE ABOVE L.O.S.* |

*NOT REQUIRED FOR EFFECTIVELY GROUNDED NEUTRALS

FIG. 3

pertinent clearances from the non-grounded electric conductors are observed. Obviously this one could prove to be a god-send where the neutral is in the lowest position on the electric pole. It's intended to encourage common pole crossings. I shall have a bit more to say on this a little later, but for the moment, I would like to move on and spend a few minutes on wire crossing clearances made in the span.

Probably one of the most common power distribution systems we encounter today is the 7600 volts-to-ground multigrounded wye. Wire crossing clearances have been affected here as elsewhere,




| | FIFTH EDITION | SIXTH EDITION |
|---|---|---|
| 750 TO 8,700 VOLTS | | |
| "A" | 40 IN. | 40 IN. OR FINAL SAG OF POWER WIRE PLUS 30 IN. IF GREATER |
| "B" | 30 IN. | 30 IN. MUST BE 30 IN. ABOVE L.O.S. |
| 8700 TO 50,000 VOLTS | | |
| "A" | 60 IN. | 60 IN. OR FINAL SAG OF POWER WIRE PLUS 30 IN. |
| "B" | 45 IN. | 45 IN. MUST BE 30 IN. ABOVE L.O.S. |

FIG. 4

by the new definition of circuit voltage again because the dividing line between the basic four foot requirement and the basic six foot requirement was 8700 volts between wires. You may recall the specific exception made for grounded wye circuits of this voltage class – a basic four foot clearance or better was obtained at the same time. Otherwise the six foot requirement governed.

As you will note in Figure 7, the line-of-sight portion of this rule has been waived and the four foot rule now applies as long as the crossing is not horizontally within six feet of a pole of another line. You will also note the clearance required for effectively grounded neutrals of this class has

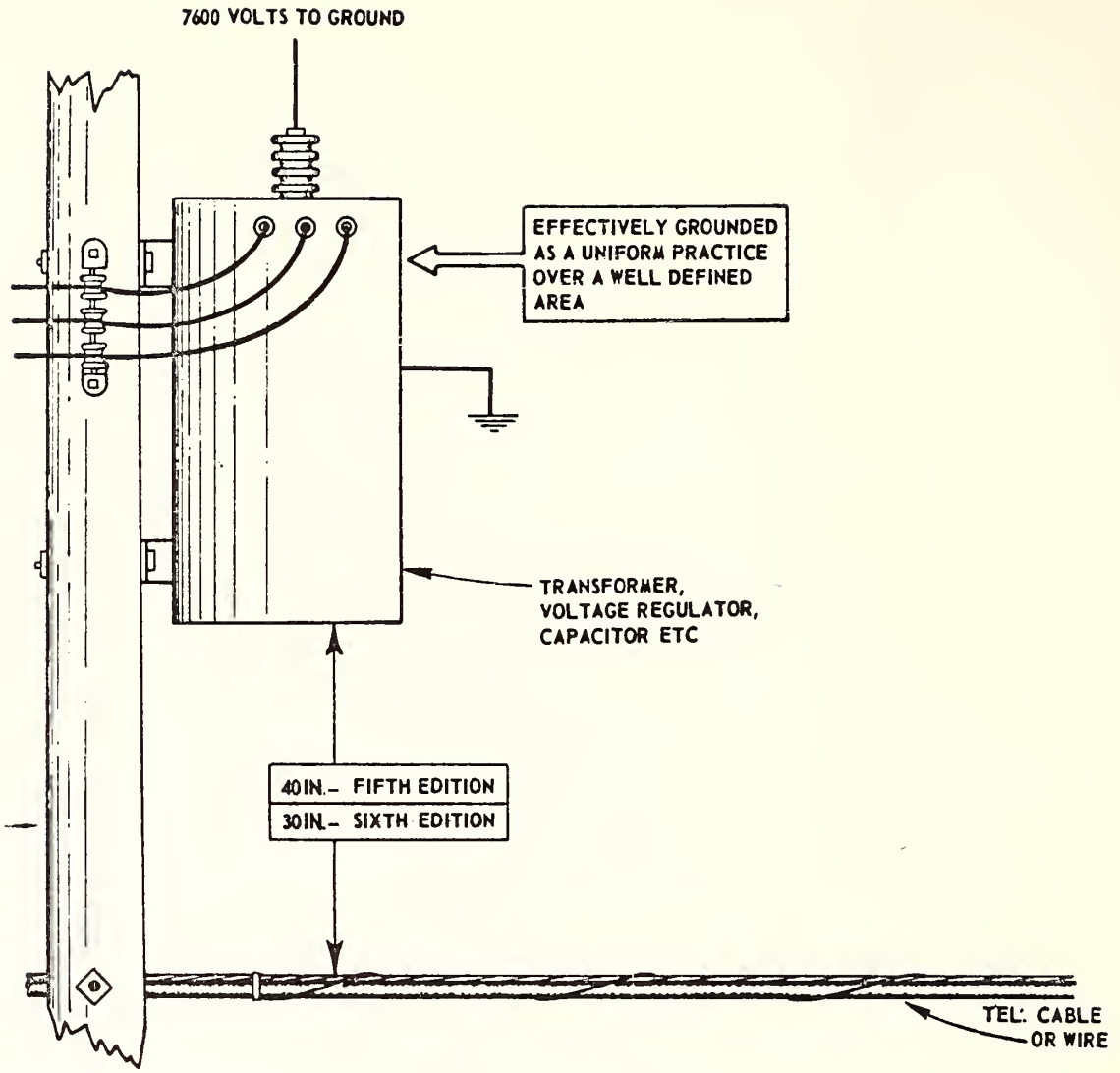

7600 VOLTS TO GROUND
EFFECTIVELY GROUNDED AS A UNIFORM PRACTICE OVER A WELL DEFINED AREA
TRANSFORMER, VOLTAGE REGULATOR, CAPACITOR ETC
40IN.- FIFTH EDITION
30IN.- SIXTH EDITION
TEL. CABLE OR WIRE

FIG. 5

been dropped from four feet to two feet. Because of a change in the rule classifying such neutrals, this same two foot clearance also applies to neutrals of effectively grounded systems up to 22KV to ground – roughly 34KV phase-to-phase. (See Figure 8.) No change has been made in the treatment of neutrals of systems more than 22KV to ground, however.

This reduction is not unreasonable. After all, neutrals are connected to anchor guys, metal conduit, water pipes etc., and all of these things are touched by the general public every day of the week. You may ask why the limit of 22KV to ground if neutrals are so harmless. First, it appeared that 22KV would cover any distribution system now even on the horizon, and distribution facilities represent a very high proportion of all electric wire mileage.

While we are covering higher voltages, let us see what has been done to clearances for potentials in excess of 50KV. The Fifth Edition used an increment of ½ inch per 1000 V of excess above 50KV. This becomes a fairly large factor for extra high voltage lines such as have been built in the last five or ten years. The Sixth Edition reduces this increment to 4/10 inch which is still comforable above the spark-over distance for 1000 volts. This reduction is not radical.

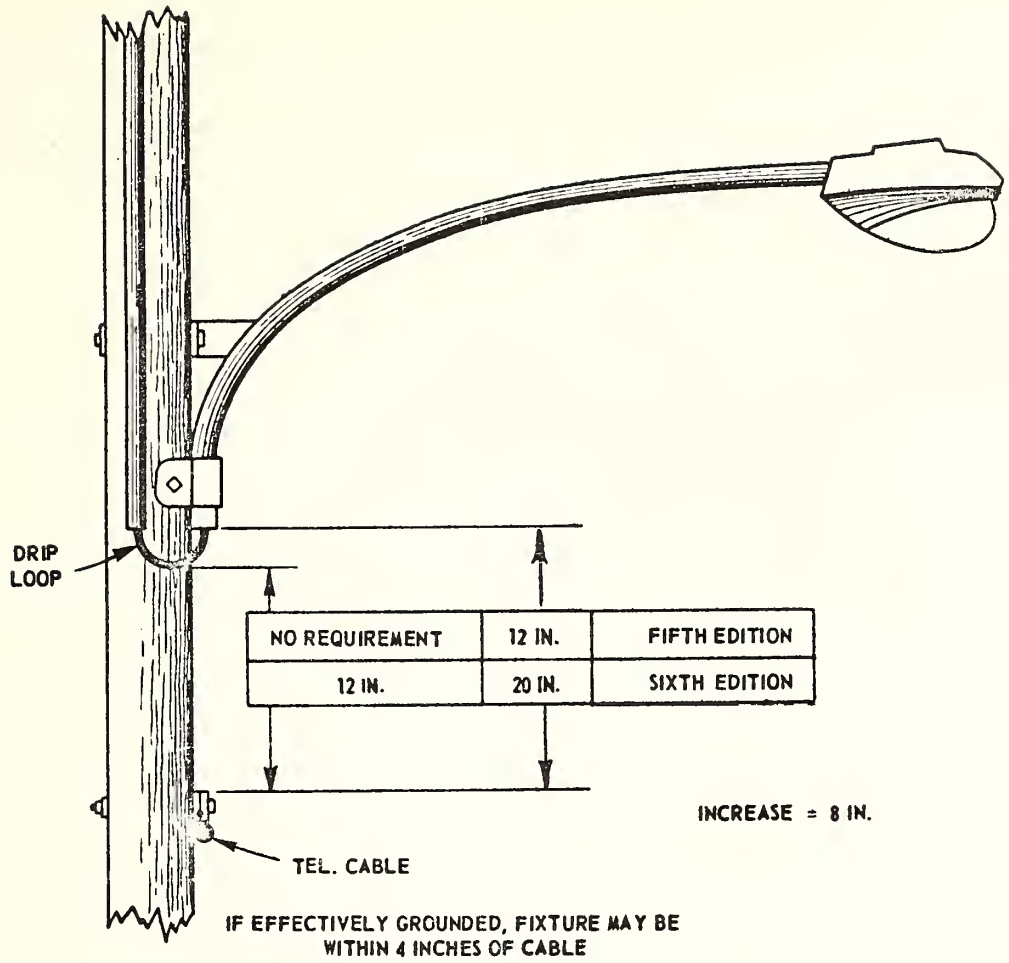



FIG. 6

Figures 9 and 10 illustrate the effect of this reduction on road crossing clearances and also clearances crossing above telephone facilities. For 110KV the reduction is 17 inches. Even for 345KV, the reduction is only a matter of 29½ inches – say 2½ feet. Note that clearances above ground and above telephone facilities have been changed by exactly the same amount. Since ground clearances for telephone facilities remain unchanged, except for long span construction in one particular circumstance, the problem of getting a telephone line under a high voltage transmission line remains pretty much the same.

Obviously, if clearances for transmission lines are based upon voltage-to-ground instead of voltage between wires, clearances will be reduced by considerably more than the amounts mentioned earlier. Returning to our 110KV line for a moment, on this basis clearance above telephone lines or roads would be about 2 feet less than Fifth Edition requirements. On the same basis, our 220KV line would be permitted a reduction of about 4½ feet. Minimum clearance above a telephone line would be about 8½ feet, compared to about 13 feet under the Fifth Edition rules. There is no reason to believe this is going to create any new or increased hazards to telephone plant or personnel.

Despite the rather liberal use of sketches showing wire crossing clearances, I hope you will not get the impression that the Bell System no longer believes in common pole crossings. Nothing could be further from the truth. We have learned the hard way that span crossings are far more dangerous to plant and personnel than common pole crossings.

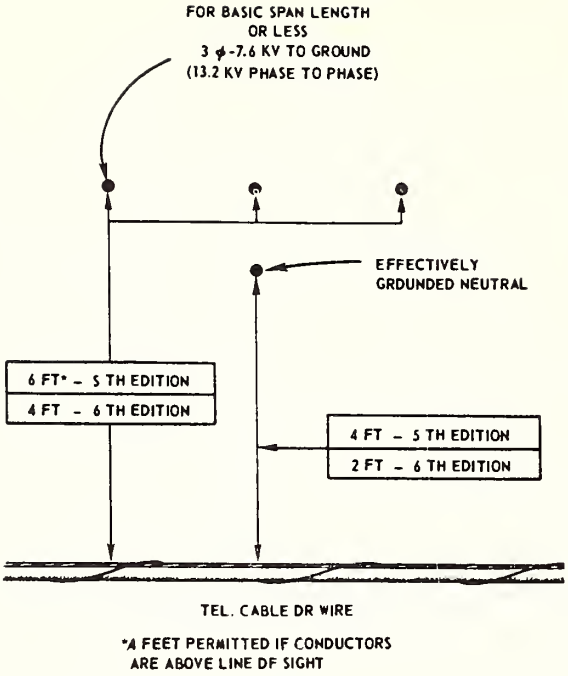
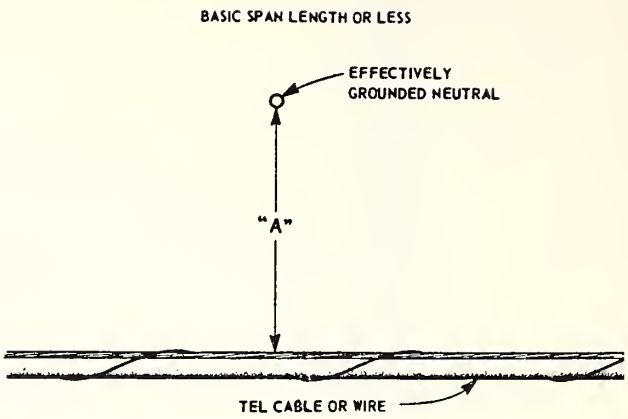

FOR BASIC SPAN LENGTH
OR LESS
3 ϕ -7.6 KV TO GROUND
(13.2 KV PHASE TO PHASE)
EFFECTIVELY
GRDUNDED NEUTRAL
6 FT* - 5 TH EDITION
4 FT - 6 TH EDITION
4 FT - 5 TH EDITION
2 FT - 6 TH EDITION
TEL. CABLE DR WIRE
*A FEET PERMITTED IF CONDUCTORS
ARE ABOVE LINE DF SIGHT

FIG. 7




| CLEARANCE "A" IN FEET | | | |
|---|---|---|---|
| PHASE TO PHASE VOLTAGE | FIFTH EDITIDN | SIXTH EDITION | REDUCTION |
| 14,000 | 4 | 2 | 2 |
| 34,000 | 6 | 2 | 4 |
| 44,000 | 6 | 6 | 0 |

FIG. 8

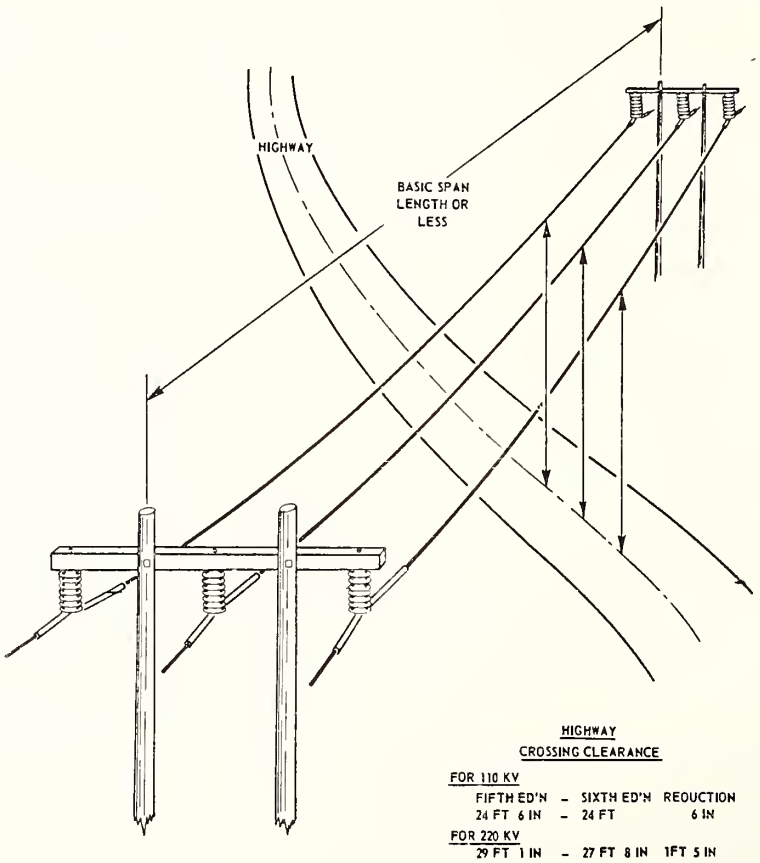



FIG. 9

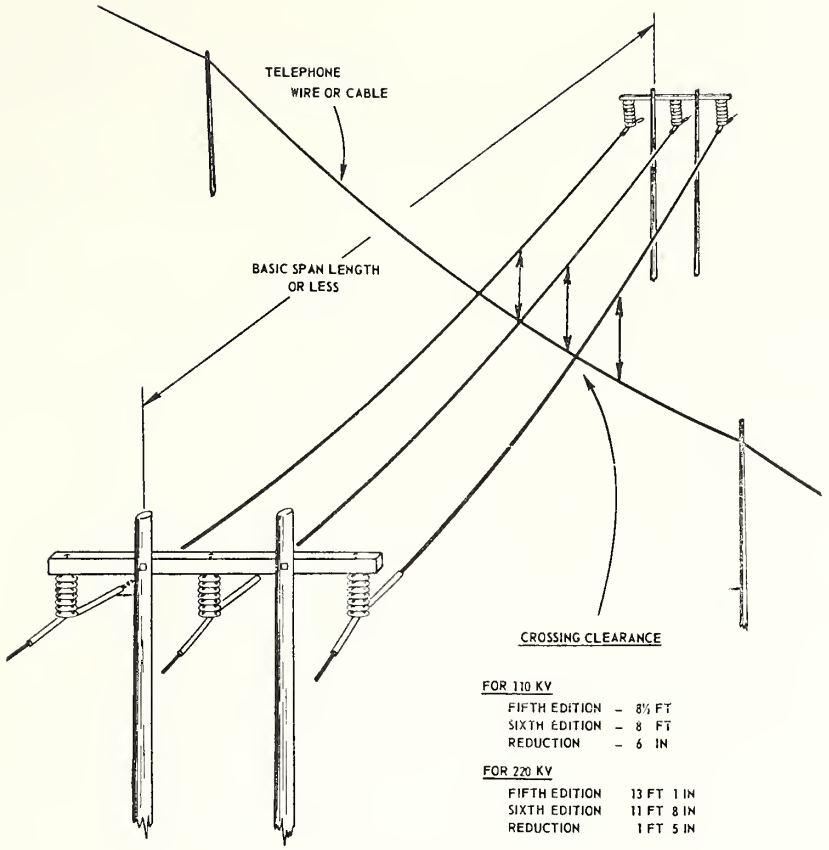



FIG. 10

In 1961 we had one man killed when a bulldozer struck the guy of a power pole and caused primary conductors to sag down onto the telephone line. Our man was working 16 spans away. We had two more serious accidents that nearly resulted in fatalities last year during the course of removing wire at midspan crossings. (These were flip-up cases.)

We had another killed last yeaa when he contacted a 2400KV primary wire directly above him but not attached to the pole. This particular case involved clearances less than half of those required by the Code. All four of these accidents almost certainly would have been avoided by the use of a common crossing pole.

We know conductors stretch under load, anchors tend to creep under load, poles may lean or settle in the ground. All of these and other factors make for variable clearances. Crossings made on a common pole, however, have fixed unvarying clearance. Far from advocating midspan crossings, it has been and still is our deliberate policy to seek common pole crossings wherever this is at all practical. Adequate fixed clearances are our first line of defense against electric shock accidents and plant damage in these situations.

I have spent a good bit of time elaborating on clearances involving conductors operated at primary, sub-transmission and transmission line voltages. Let me emphasize, however, low voltage clearances are important too. We have had enough people killed by 115 volts to be quite respectful of it, and I'm sure you have too. Let me cite just one case. A 115 volt conductor sagged down on some telephone wire a few years ago and killed a man working on a pole nearly 7 miles away. The voltage was too low to operate protectors and the current too small to burn the contract free, or blow a fuse but it was lethal just the same.

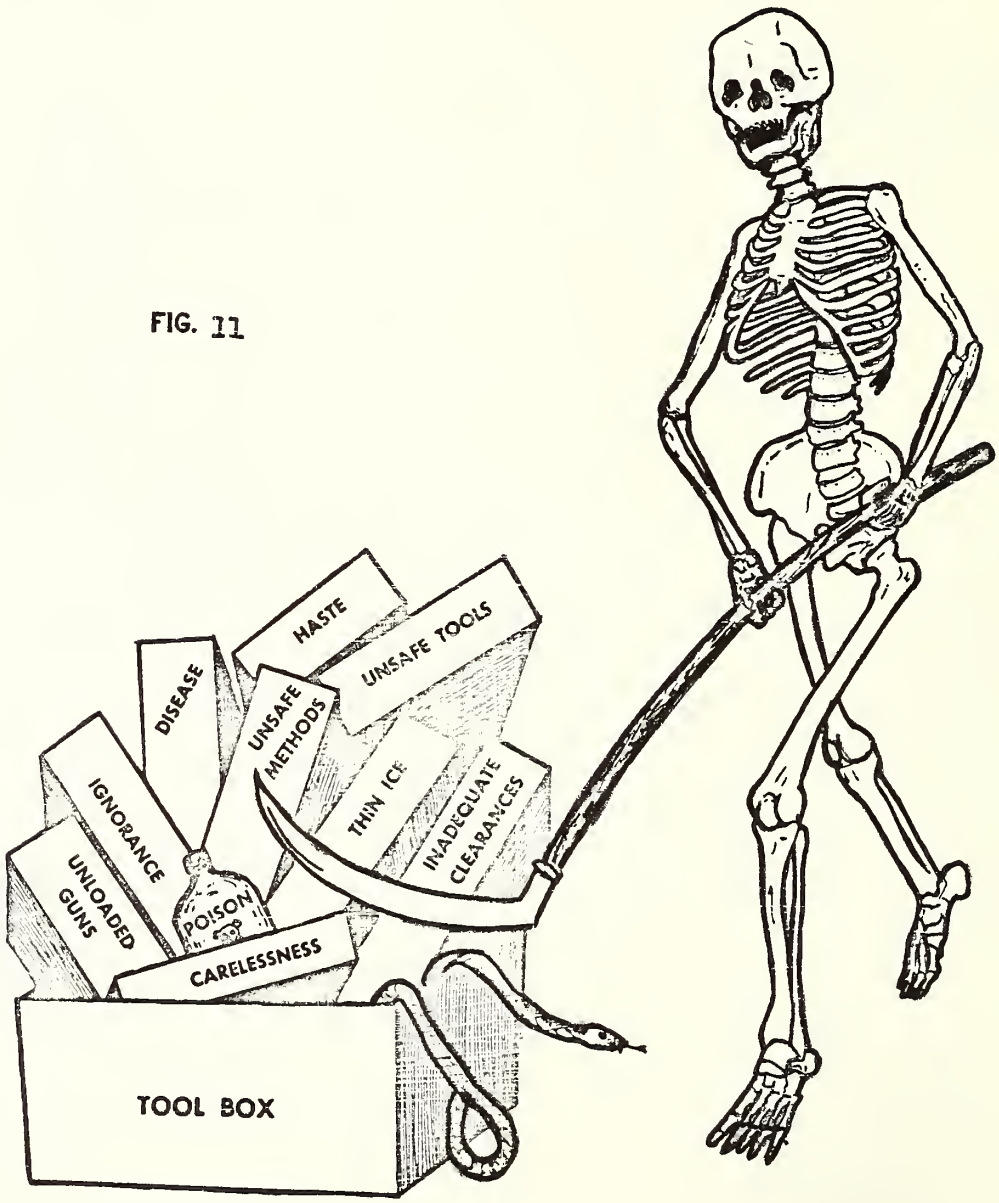
There can be no doubt that inadequate clearances have been a factor in the death of a number of Telephone workmen, and electric workmen too. The record is pretty plain on thad score. To be sure,

inadequate clearances weren't the only factors. In experience, carelessness, ignorance, poor supervision, lack of training, haste, and a number of other things enter into the picture. These are just a few of the many items in the tool box of the Grim Reaper.

We know how to build safe plant. The rules of the Sixth Edition are going to let us build it a little more economically than before but no less safe. Power and telephone people will agree, I'm sure that plant built with a standard clearances is safer, and in the long run, more economical than with substandard clearances.

In closing, may I say it has never been enough to merely know what proper clearances were; we have always had to take steps to be sure we were getting them. The Sixth Edition offers the bright promise of considerable economies in construction, but it also means we have a job to do in educating the people as to just what the new requirements are. So let's take a look at Figure 11 to emphasize some of our short commings and plan to do a better, safer job under the new Code.

FIG. 11



# PREVENTING BIRD DAMAGE

By

John V. Dennis, Biologist

Koppers Company, Inc.

Leesburg, Virginia

## PREVENTING BIRD DAMAGE

Although I am going to talk mainly about woodpecker damage to utility poles, a few words may be in order about bird and wildlife problems generally.

It has been said that nature abhors a vacuum. And this is only too true when it comes to the attempts by man to seal off, so to speak, parts of his domain from the ravages of nature. We are highly successful, in many instances, in protecting our property from specific kinds of loss and damage. I know I do not have to remind you of the progress made in protecting wooden utility poles from attack by fungi and insects. But I am sure that many of us have been confused and disturbed by the fact that a wooden pole, chemically isolated so far as myriads of minute forms of life are concerned nevertheless remains an alluring place apparently for a host of other creatures. If anyone is doubtful about the abundance of life on, say, a well creosoted transmission pole, I suggest that he view such a pole when the light is right and see if it is not festooned from top to bottom with the shiny silken lined of the jumping spider. Or again, on a warm winter day in almost any part of the South, I suggest that well treated poles be examined for emerging wasps of the genus *Polistes*. These wasps hibernate in the checks and empty throughbolt holes of countless utility poles, and on warm days they come out of their crevices to fly around for awhile.

I scarcely need to confine myself to lower forms of life. We are all aware, and often painfully so, of the squirrels that insist, with suicidal curiosity, in climbing electric poles to test the voltage with their long furry tails. And I am sure that we are aware of our many feathered friends that congregate upon the cables and arms and tops of poles; they do this without any harm to themselves, as a rule, but the droppings of some, particularly the vultures, cause a corrosion problem with cabling, and some of the others, especially the house sparrow, seem to insist upon building their nests as close as they possibly can to hot wires and transformer terminals.

Here in Florida I am sure that many of you are familiar with the osprey or fish hawk. Along the seacoast and near inland bodies of water as well this bird builds its huge platform nest of sticks in dead trees or, increasingly in recent years, on the arms or tops of utility poles. And if you think this is hazardous from the standpoint of flashovers, I need only mention a raven of the Southwest that in recent years has taken to building its bulky nest of pieces of scrap wire – the favorite site for this wire nest is on the arms or tops of utility poles.

Why, it may be asked, is there such pressure by wildlife upon a part of our landscape that seems outwardly, at least, to offer little in the way of food or shelter? Is this a response, so to speak, to fill a vacuum, to find living room that isn't already taken up?

To learn the answers to these questions we would have to examine each particular animal in detail, its habits and its reasons for being on utility structures. And I think we would find in the greatest number of cases that the utility pole served the animal in some incidental way, say, a lookout for a bird of prey, and that the presence of the animal was neither harmful nor beneficial so far as utility interests are concerned.

But we are concerning ourselves today with damage problems and foremost in our minds is that caused by the most destructive of all furry or feathered visitors to utility poles; namely, the woodpeckers. At our first Southeastern Wood Pole Conference, I reviewed this problem of woodpecker destruction with you. At that time I did not have a solution to offer you or even much hope of a solution. I feel we have come a long way since then. As many of you may know, Koppers Company since a year ago has been offering to utility companies a taste repellent paint or grease to apply to the external surfaces of poles and a hole filler to safeguard holes and cavities from further woodpecker attack.

Before getting down to this solution, let us see if we can determine why the woodpecker, with all the trees of the forest at its disposal, chooses the utility pole for its special attention. Is this an example of nature rushing in to fill a vacuum?

In a way, I am convinced it is. Wherever you find woodpeckers overly attentive to utility poles, you can be sure that there is an element of competition involved. Utility poles are important to woodpeckers – not so much for anything the pole has to offer in the way of food or shelter, but, as we

shall see, as an outpost from which the woodpecker can guard its territory. To be sure, the birds are on the poles for a variety of purposes: to pick insects off the surface of the pole or to obtain hibernating ones out of checks and cavities, to store food, to break open food, to eat food, and to excavate roosting and nesting cavities for themselves.

These last are all activities that normally the woodpecker can better perform on dead trees than on utility poles. Many of us, myself included, at one time or another have assumed that it was a shortage of dead trees that drove woodpeckers to utility poles. After two years of concentrated research on the woodpecker problem – most of it in Texas – I have discovered that some of the heaviest damage to poles is on lines through heavily timbered areas containing a large percentage of dead timber. In fact, in one area of heavy attack in Texas the oak trees had been girdled in order to promote the growth of pine. And turning to Indiana, where the Public Service Company of Indiana has long had serious problems with woodpeckers, I learned that they experience some of their severest attack after portions of forested areas, near which their lines run, are flooded through the construction of reserviors and, as a consequence, there is a partially submerged forest of dead trees.

Nearly every company that I have visited that has had a serious woodpecker problem has tried leaving a few badly attacked poles in place, this with the expectation that the birds would stay with the old poles and not bother the new replacements. The results have almost always been disappointing. In perhaps nine out of ten cases the birds have abandoned the old poles and gone to the new ones.

So often have maintenance people experienced this kind of thing that many of them have become convinced that utility poles, especially new well treated ones, have a special appeal to woodpeckers. I have frequently been told that the birds must like the taste of creosote or penta. Or a more penetrating reason is that the birds seek out the wood preservative in order to rid themselves of lice or other external parasites. And finally there is the argument that it is the hum in the wires that attracts the birds to the pole.

To go into these and other suggested reasons in any detail would be beyond the scope of this paper. But I would like to point out that woodpeckers I collected from utility poles in Texas were examined for external parasites by the entomology department at Texas A. & M. College, and all were found to be particularly heavily infested. In other words there was no evidence that contact with creosoted poles had had any effect in reducing infestations upon the birds in question.

As for the hum in wires as a cause, this suggestion is contradicted by numerous examples of heavy attack upon new poles before the wires were strung. Indeed, I recently examined a line in Texas where right-of-way difficulties had held up construction. The poles had been set eight months ago; some sections were wired, others weren't. Woodpecker attack was occuring along much of the line and there seemed to be no relation between the attack and the presence of wiring or other attachments.

To go back to competition among woodpeckers and their habit of guarding territorial rights, we have in this, I believe, the most important reason by far for pole attack. In the woodpecker, as in most birds, we find a strong inherited instinct to protect certain areas at certain times of the year from trespass by other individuals of the same species.

Defense of the nesting territory, a function that occupies woodpeckers in this latitude from about March until early summer, is usually much more determined than the defense of the much larger feeding territory. However when food is less plentiful, as is generally the case in winter, defense of the feeding territory may be quite determined.

But how, it may be asked, does the utility pole play a role in the woodpecker's defense of its territory?

First of all, the utility pole is out in the open where the woodpecker can watch in all directions for signs of trespass. His rivals, if he has any adjacent to his territory, are also likely to be on utility poles at points farther along the line in both directions. From perhaps two or three particularly well situated utility poles a woodpecker may not be only able to guard a large part of his territory, but, at the same time, he can keep track upon his neighbors, sometimes, no doubt, with the motive of invading their territories in quest of a mate or for food finding. Ordinarily dead trees are not nearly so well situated for making observations of this kind.

Secondly, the right-of-way of a utility line through a forested area cannot be expected to correspond with the irregular boundaries of the many woodpecker territories that may be present. Territories in the path of a new right-of-way would be subject to being diminished in size and often divided or sub-divided. This in itself would be reason for an increase in competition between woodpeckers and and added reason for them to be on guard on utility poles.

Let us suppose that a new line has been built through a forested area. Certain poles, because they command vantage points so far as territorial defense is concerned, are visited more than others. These observation poles, as they may be called, will not only be guarded, but, particularly if we are dealing with the pileated woodpecker, they will be heavily attacked. This kind of attack serves no useful purpose so far as food or nesting is concerned. The holes are made perhaps as a diversion from the monotonous routine of guard duty, or perhaps, even more likely, to let woodpeckers in adjacent territories know that the pole is occupied. In time, as the birds adjust to the changes made by the the right-of-way through their territories, the defensive behavior can be expected to slacken off. Along one right-of-way in Texas, for example, I found that five years after the line was constructed, pileated attack, which originally had been severe, had fallen off to almost nothing. Generally speaking the heaviest attack upon a pole occurs during the first year it is in place. Poles that escape this initial attack are likely to remain free of severe woodpecker attack. To be sure, almost any pole may receive light damage along checks and whatever other places hibernating insects may seek refuge for the winter.

It is a common occurrence for maintenance crews to have to change out woodpecker damaged poles at the same locations year after year. No wonder suspicion arises as to new poles being more susceptible to attact than old ones. But as I would like to point out, there is nothing about the condition of the wood in the pole or the treatment that the pole has received that brings on this attack. It is a matter of location. If the pole is at a location that is meaningful in relation to territorial defense or if it is a location that the birds have selected for a roosting or nesting site, then it will almost invariably be attacked.

Oldness per se, at the same time, is no guarantee against woodpecker attack. Indeed very old poles may become subject to serious insect infestation. This in itself may stimulate woodpecker attack. Or there may be a situation such as was reported to me by the Public Service Company of Indiana. A twenty year old line through a densely wooded area suddenly began for the first time to come under pileated attack. The explanation seemed to lie in the expansion and increase of the pileated in this part of the state. As the birds moved into this area and began claiming territories, they resorted to the usual practice of selecting out certain of the poles for special attention.

Generally speaking woodpeckers need to be so numerous that they are competing with each other before a serious pole damage problem can come into being. This is why a superabundance of dead trees can be expected to mean an increase in woodpecker damage to nearby utility poles. Dead trees provide the added nesting sites and added insect life that makes for an increased density in the woodpecker population. But it must not be assumed that woodpecker populations will automatically decline with the removal of dead trees. The birds are quite capable, in many instances, of making nesting holes in living trees, and it scarcely need be mentioned that utility poles often serve this purpose. In the heavily wooded areas of east Texas, I found that roosting and nesting holes accounted only five percent of the damaging holes in transmission or distribution poles. In south Texas, on the other hand, where arid conditions prevent the development of sizable trees, the ratio of roost and nest sites in poles is much higher. Indeed, the ladder-backed and golden-fronted woodpeckers, the two common small woodpeckers of this part of the country have the habit of excavating their nest holes in crossarms of distribution and telephone poles or the braces on transmission poles. They always begin these holes near the tips of crossarms and the entrance is always on the underside of the crossarm or brace. I have never seen any variation from this pattern in the hundreds of examples I have seen. In most cases the birds never complete these holes. Very often they show themselves to be poor judges of the dimensions of the wood they are excavating. They will widen their holes to the extent that they form "windown" in the sides of the crossarms or braces, or they may work upwards too far and punch a hole in the roof.

By now you may be telling yourselves that we must have a versatile and effective product if we propose to stop woodpecker attack in all the many forms it takes.

We do believe we have something that is versatile for we have a "paint on" repellent grease that can be used to stop woodpecker attack before it begins or to prevent further attack on poles that are already damaged. This repellent grease comes in 40 or 240 pound drums. Ordinarily it is applied with a four inch paint brush, the pole climber starting from the top of the pole and working downward. The pole must be thoroughly coated with no skips or gaps and the application must be as thick as paint brush use permits. This is not to say that the entire pole must always be painted. If we are out to repel the pileated woodpecker, the lowest portion of the pole need not receive attention. This species ordinarily does not attack a pole any lower than six or ten feet. Attack by the pileated is usually upon transmission poles and the mid-section of the pole is the most vulnerable part. The flicker, a woodpecker generally not very damaging to poles in the South, centers its attack, as a rule, upon the lower half of the pole. Many times this woodpecker builds its nest hole within three to ten feet of the ground. To insure complete protection from the flicker, it is safest to coat the entire pole down to a foot or two from the ground.

Most of us here, I am sure, are familiar with the red-headed woodpecker. This small, brightly colored bird is frequently found in towns and cities, and, in fact, there are a number right here on the campus. This woodpecker is a problem to poles locally. Its attack is frequently confined to the top two or three feet of a pole. In such cases, good results can often be had with the application of a pound or two of repellent grease to the upper-most portion of the pole. In areas where attack is lower additional coverage will be required.

In the Southwest one of the major problems is the one I have already mentioned, the attack upon the undersides of crossarms and braces. In California and parts of Arizona and New Mexico there is a destructive woodpecker quite closely related to the red-head. This bird, the acorn woodpecker, has the habit of endlessly storing acorns in small crevices it makes in fence posts, trees, and, above all, utility poles. The bird also has the habit of frequently building its nest hole in utility poles.

Our product must be versatile to meet all these many kinds of attack. We not only have the exterior of the pole to consider but also the holes that woodpeckers have made in the past. These old holes, in many cases, are not structurally damaging to the pole, but they do open up the interior of the pole to moisture and decay. We offer a hole filler as a solution to this problem. The filler differs from the repellent grease in being heavier-bodied because of a mineral additive. Like the repellent grease, the filler contains the repellent chemical, the grease additive to take the chemical into wood, and a wood preservative in the form of pentachlorophenol. The presence of the latter is especially important in the case of the filler because so many woodpecker holes penetrate into untreated wood in the interior of the pole. The hole filler comes in 60 pound drums and is of a consistency that would permit the use of a trowel in filling woodpecker holes.

A pole surface treated with the repellent grease dries in about four to six weeks. Both the repellent grease and hole filler must be handled with care. While the repellent chemical itself is classified as not highly toxic to man it can produce, if not properly handled, irritation to the skin. And, together with the penta additive, it must be emphasized that the repellent grease be kept out of the eyes. The pole climber who applies the repellent, therefore, must wear rubber gloves, goggles or a face mask, and he may expect possible staining of his clothing if he allows himself to be splattered as he paints.

Turning to *effectiveness,* the other essential of our product, we know that both the hole filler and repellent grease do the job they were designed to do. They stop woodpecker attack. Late in 1961 we began extensive testing in cooperation with several Texas utility companies. Results were so promising that we felt justified in making our product available commercially in May of 1962. We did not know the life expectancy of the repellent. But to get these answers we felt there was a need to test on a much larger scale and on a continent-wide basis. Therefore we asked our utility customers to set up testing programs of their own. We supplied test forms upon which they could record the results they obtained.

We have been greatly pleased over the results of this large scale testing. We are particularly pleased over the way the pileated woodpecker has been repelled in areas where nothing has been

able to stop the bird in the past. For example, test results in Texas, Mississippi, and Tennessee show complete success on several lines where hardware cloth had failed to give protection. In fact a pole in Tennessee, prior to the application of our repellent, had continued to receive pileated damage in spite of double and triple layers of hardware cloth. This damage ceased altogether after the hardware cloth had been removed and our repellent applied in its place.

We nevertheless continue to ask our customers to test our product on a few poles under severe attack before they begin making large scale applications. We want them to keep in mind the unforeseen, and to let us know if they experience any difficulties or disappointments. We are especially anxious, for example, to learn the life expectancy of the repellent chemical. The chemical is a coal tar derivative with durable qualities. We anticipate good effectiveness for several years.

I am sure that many of you would like to be able to order pretreated poles. While it has not been practical for us to incorporate the repellent chemical in the preservative at the time of treating, we are coating with the grease repellent at our yards.

While I know I have left many questions unanswered, I would like to clarify one further point. In the case of standing poles, by treating only damaged ones or ones that are replacements for woodpecker damaged poles, are we not encouraging the woodpeckers to move along to poles that have never experienced any damage in the past? To answer this question I must go back to my earlier discussion of defense of territory. As I mentioned in that connection, the woodpecker is only going to attack a pole that is in some way meaningful to it. Poles that have escaped past damage have no meaning to the bird and therefore will continue to remain unmolested. We have seen this over and over again in our experience in testing.

I should point out, too, that the fact that a pole is treated with our repellent does not prevent the bird from alighting on the pole and continuing to conduct its observation routine as in the past. The The repellent acts only to stop the bird from its harmful excavating.

Also on this question of territory, we have sometimes been asked what happens when one or both of the woodpeckers occupying a territory die? Does this not upset the territorial boundary system to the extent that new poles will come under attack? I think not. A new bird or new birds will immediately come in to occupy the vacant territory. There would be little change in boundaries because surrounding territories are already occupied. Poles or dead trees that served as lookouts in the past, because of their locations, would probably continue to serve the same purpose. In short, there should not be a tendency for newly arriving woodpeckers to attack poles that have escaped damage in the past.

In a way you might say that the woodpecker is one of the most conspicuous indicators of what takes place when man, in his efforts to stop one form of incursion by nature, finds another invader to take its place. Something always comes in to fill the vacuum. I do feel, nevertheless, that problems such as these can be overcome, and I have been happy to have had this opportunity to bring you our solution to the long standing problem of woodpecker damage to poles.

# EXTENDING WOOD POLE LIFE IN PLANT

By

E. L. Lancaster, Transmission and Distribution Engineer

Louisiana Power and Light Company

New Orleans, Louisiana

## EXTENDING WOOD POLE LIFE IN PLANT

The remarks that will be made here by me today approach this topic from the practical side. It should be understood, however, that this is only one utility's approach, namely, the Louisiana Power & Light Company. It considers those factors and experiences that effect us—and these may be quite different from yours. However, there is one most important factor that is common to us all. This is *safety*. One of the most important responsibilities of the utility company is that through neglect the in-line pole does not become a safety hazard which may cause injury, death or property damage.

This safety factor weighed heavily in favor of our decision to initiate a groundline treatment program.

To help orient you to my approach of this topic, I have listed a number of questions that I will attempt to answer. These questions include:

1. Where does extending pole life in plant first begin?
2. What do we consider as a practical approach in trying to provide an economically sound pole in the line?
3. Why did we enter into a groundline inspection and treatment program?
4. What formulations of preservatives are we applying?
5. Why did we elect to contract this program?
6. What are the expected benefits to be derived from this program?
7. What is this program costing?
8. What value do we put on this service?
9. What checks are being made to determine whether this program is being beneficial or not?
10. What steps are being taken to safeguard the poles from damage by woodpeckers?
11. What steps are being taken to safeguard poles against damage or destruction by marsh land fires?

The latter two questions will only be touched on briefly. The questions to be covered in more detail are related to the subject of groundline inspection and treatment.

From the agenda of today's conference, it can be seen that every topic on the program is either directly or indirectly related to extending wood pole life in plant.

The first question asked is where does extending pole life in plant really begin? You might say it begins with the pine seedling. The United States Forest Service and its allied agencies, through research and development, have outlined programs for today's tree farms that are continually improving the quality of trees from which to produce poles.

When does the utility company have its first opportunity to do those things that should aid in extending pole life in plant? Indirectly, the utility can give its support and co-operation to the Forest Services and the American Wood Preservers Association and Institute. I might add that my company just recently applied for membership in the AWPA and I urge all other utilities that are not already a member to apply for membership. This organization is doing much for the benefit of utilities and thus warrants their support. The first direct opportunity afforded the utility for extending pole life is in the specifications under which it purchases poles.

Four years ago, our Engineering and Purchasing Departments, with the assistance from pole producers and our pole inspection agency, undertook to re-evaluate our pole specifications. A paper presented by Mr. J. A. Vaughan at the Southeastern Electric Exchange meeting at Clearwater, Florida, April, 1959, titled "Practical and Economical Specifications for the Selection, Care, and Treatment of Poles for Utility Use" was also used as a guide in developing our present specifications. I would like to summarize the results of these specifications, giving the "whys" for doing so.

Periodically, complaints arose from our operating personnel concerning poles and pole purchases. After the revised specifications were finalized, this, in part, is the accompanying explanation that was attached to each copy of the specification.

"The attached specifications are the result of much study, a number of field trips, anal-

ysis of pole treatments performed by treating plants in our service area, knowledge and practical experiences gained from other utilities at pole seminars.

Economy in preservatively treated poles lies largely in the specification under which they are purchased, the care given them from forest to treating cylinder, preservative retention and depth and uniformity of preservative penetration, and to a lesser extent the pattern of pole purchases. Care of the untreated wood during its preparation to receive the preservative is probably the most important factor in long and satisfactory pole life, which is really pole economy. A thorough understanding of forest growth and the many and varying characteristics of trees and wood itself played an important part in the preparation of these specifications so as to assure pole quality and resulting economy.

Pole grow much like people and for much the same reasons. The availability of food and sunlight, ability to assimilate the food present, and other factors, all combine to determine the height and girth of a tree at any given age. Like people they may develop tall and slim, short and fat, tall and fat, or short and lean.

The American Standards Association (ASA) issued pole specifications in 1948, a copy of which is included for your information since our specification here are based on ASA. ASA Specification is the result of long study and many tests, all done by a large committee composed of men who know poles and what is required of them, also men who know forest growth and what nature produces. No doubt there were some compromises made, but the specification is a practical one to make the most economical use of woods-run pole timber and assure structures that will take the loads and give highly satisfactory service when properly preservatively treated. The stress values of ASA have been adopted by the National Electric Safety Code.

Recognizing the aforegoing to be true, in drawing up our specifications, ASA has been adhered to as closely as possible. Our two biggest problems have been pole failure from groundline rot and breakage of poles naturally weak at points of knot clusters or groups of knots. Exceptions to ASA have been drawn up to help assure a well-preserved pole and to restrict the sum of diameters of groups of knots."

The exceptions to ASA under knots reads thusly:

**Knots**

> The sum of the diameters of all knots in any 6 inch section shall not exceed one-third (1/3) of the circumference of the pole. In those cases where one-third (1/3) of the circumference is *greater* than 10 inches, the sum of the diameters of all knots shall be limited to a maximum sum total of 10 inches. Knots 1/2 inch or less in diameter shall be ignored in applying these limitations.
>
> The point of measurement of the circumference shall be made around the pole surface just below the knot enlargements.
>
> In order *not* to penalize Class 6 or poles smaller than Class 6, the following exception will be allowed: Where one-third (1/3) of the circumference is less than 6 inches, the permitted sum of the diameters of all knots in any 6 inch section shall be 6 inches.

## Preparation for Treatment

Only green material shall be acceptable for poles. This requirement was adopted to lessen the chance of the fallen timber to become infested by fungi. By reducing the time lapse between forest and treating cylinder, the likelihood of the timber to become infested is lessened.

Under treatment is specified the retention of preservative shall be 12 pounds per cubic foot for all poles. A borer core shall be taken approximately midway between the large and small end of *all* pieces and only those pieces meeting the penetration requirements shall be accepted. To date, we are not using the assay method of determining preservative retention in poles.

Prior to 1957, only 8 pounds retention was specified for distribution poles; however, 12 pound retention has always been specified for transmission poles on our system.

What brought about this change from 8 pounds to 12 pounds on all poles? In 1957, our attention was focused on our poles in plant because of the increasing number of early failures that were showing up in poles installed in the years 1945 through 1950. We learned, probably the same as many of you here, that the early failures in the poles of this vintage were resulting from the use of an inferior grade of creosote. Due to our defense needs, this was the only creosote available at the time for use by the producers. This condition was corrected by the producers as soon as better grades of creosote were once again available. But even so, at the time, we figured that, by increasing the poundage of

preservatives to be retained in the pole, this should extend the useful life of the pole. At today's prices, the differential cost between 8 pound and 12 pound treatment is only about 12½ cents per cubic foot of wood treated. For a 35 foot, Class 5 pole, the price differential is about $2 per pole. We feel that the additional cost paid for the 12 pound treatment is well worth the added cost.

These early failures led Louisiana Power & Light Company into a program of groundline inspection of poles. In late 1957, we entered into this groundline treatment program—not because of the "sales pitch" which offered extended life of the pole as promoted by the treating company—but because we needed to inspect the poles in service. The paramount reason of the inspection was for the purpose of locating dangerous poles. From the standpoint of safety, these poles needed to be located and replaced.

We felt that a contracted program offered a more economical way of getting a thorough inspection of the poles by a qualified and experienced inspector rather than by the company trying to undertake a similar program using company personnel.

A satisfactory pole inspection calls not only for adequate training and experience, but also for interest and tempermental suitability on the part of the inspector. We felt that by employing a company primarily engaged in this type of work we would end up with a better inspection and treatment job.

Should the preservative prove effective where applied, then we could consider this as "gravy" above and beyond the benefits of the inspection. Inspection was needed primarily to point out dangerous poles that should be replaced immediately to avoid possible personal injury or property damage.

It didn't take long for us to realize from the reports received that the need of an inspection was paramount. Out of the first 18,000 poles inspected, 162 were reported dangerous. Another 1,160 poles had been classified as rejects. The rejects needed to be replaced within a twelve month period; otherwise, these, too, would likely become dangerous if left in place beyond this period.

In 1957, we entered into a contract with Osmose Wood Preserving Company to inspect and treat where necessary those poles dated with year 1950 or dated any year prior to 1950. The Osmose Company has handled this service with us every year up to the present date. In 1960, in addition to the Osmose Company, we also contracted the services of the Martin Chemical company for the application of the Pol-Nu preservative as manufactured by the Chapman Chemical Company of Memphis, Tennessee.

By applying two different formulations of preservatives, we felt we would be able to determine in time if one formulation is more effective than the other.

In December of 1950, our company had approximately 203,000 poles in plant. Nine per cent of these poles are in transmission plant. The majority of these poles were added to plant in the year 1945 through the year 1950, at an average annual rate of 16,000 poles per year. Unfortunately, these were the years that grade No. 1 creosote, as we know it today, was not available. Of course, this meant that poles being added to plant in that period would have their service life reduced considerably. Thus the company felt that about 20,000 poles per year should be inspected. This program has been on a continuing basis since 1957 with about the same number of poles being inspected each year. Since 1950, although our total pole purchases have been running at a rate of around 17,000 poles per year, only 50 per cent of these poles are placed in plant additions. The other 50 per cent are replacement poles which are installed later for one reason or another, such as for highway moves, taller pole required, or where it replaces another defective pole. The company figures that, by inspecting approximately 20,000 poles per year, every pole 10 years of age or older will be inspected once every 10 years. This means, at the present time, we are on a 10 year inspection cycle.

Since the initiation of this inspection and treating program the company has inspected 114,000 poles. Seventy-five and sixty-three hundredths (75.63) per cent of these poles have had groundline preservatives applied; 7.79 per cent of these poles have been classified as rejects with the other 16.58 per cent being reported as in good condition. The dangerous poles are included in the reject category. Dangerous poles account for about 0.8 of 1 per cent of the total rejects which, in our particular case, totals about 900 dangerous poles out of the 114,000 inspected. These 900 poles represent 900 safety hazards—any one of which could cause death, injury, or damage.

Just last year, a serviceman in one of our districts had a 30 foot service pole fall with him, causing him serious injury. In addition to the man's suffering and the hardship to his family and company, the direct cost of this accident was $13,500. Statistics show that the indirect costs of accidents run about four times the direct cost. Applying this ratio to this accident makes the total cost to the company amount to $54,000. This amount would pay the cost of inspecting about 15,000 poles. Incidentally, the company had, in force, at the time of the accident Safe Work Procedure No. 1-62 entitled "Check Wood Poles for Soundness and Strength" which this serviceman failed to follow. Had our groundline inspection program been initiated earlier to allow for having inspected every pole as outlined in our program, this safety hazard probably would have been eliminated and the accident prevented.

Today, from data received from the field reports, the change made in 1957 from 8 pound treated poles to 12 pound treated poles can now be justified as having been a sound one. The percentage of rejects of the 12 pound treated poles is 2.76 per cent. These rejects have been totaled together with the 8 pound treated poles to arrive at the 7.79 per cent figure given earlier. This has weighted the percentage of rejects in the 8 pound class to be lower than they would otherwise be.

The average cost per pole for the entire program to date is $3.62 per pole. To treat a pole costs $4.50 per pole. A pole where excavation has been completed but final inspection determines the pole to be a reject, the cost is $3.75 per pole. Reporting a good pole which entails only sounding the pole without further work costs $0.25 per pole. Sounding and boring a pole if it is thought necessary costs $0.80.

In 1961, we reinspected 92 poles that had been groundline treated in 1958. All these poles were known to have ground rot present at the time of treatment. This was done for the purpose of determining whether or not the preservative was effective.

The results of the first 42 poles inspected follows:

Four poles had internal decay not noted before. Two of these poles had their worst condition above groundline. Although it is possible that some of this decay was present at the time of our first inspection, the decay above ground definitely has developed since.

One pole had heart rot at its first inspection. No advance in heart rot noted.

Three poles had been chipped at the first inspection due to mechanical damage. No additional decay was noted.

Nine poles had a small amount of outside decay. However, removing this did not result in any further reduction of the groundline circumference.

Thirty-three poles which had previously been chipped had no decay at all.

Of the forty-two poles inspected, there were no further reductions in circumference, no rejects, no danger poles.

The nine poles with some outside decay brings out a point which often has been a point of discussion. Should the inspector remove all the decay in all instances or should he, under certain circumstances, leave a little bit of decay which, if removed, would necessitate the chipping off of some good wood in his opinion, especially if the removal of the good wood might reduce the effective groundline circumference even further.

The results of the next 50 poles inspected follows:

Forty-five poles had no outside decay

Four poles were found with a small amount of outside decay. On three poles the decay had been left by the foreman so as not to reduce the effective circumference. On one pole the outside decay may have developed since the last inspection.

Nine poles had no enlarged internal decay.

One pole with previous ID (ID means internal sapwood decay) had an enlarged ID above the groundline only. In the groundline area, the ID remained the same.

One pole had a small punky pocket at groundline not noted before.

Four poles had above groundline ID not noted before.

Four poles had received a small amount of ant or termite damage since last inspection.

Four poles were rejects, three due to internal decay above groundline and one due to brittle wood above groundline.

One pole had received a faulty inspection.

It appears that the treatment and inspection is about 86 per cent effective.

In June, 1960, an analysis was performed on a cross section of a creosoted pine stub 10 inches in diameter which had been treated in April, 1959, with Osmoplastic.

Analyses were performed on a cross section of this stub. This cross section was located 6 inches below the groundline. The first 4 radial inches of the cross section were separately analyzed for sodium fluoride. The results will, therefore, indicate both penetration and retention:

| Radial Inch From Outside of Cross Section | Pounds Sodium Fluoride Per Cubic Foot |
|---|---|
| 1 | 0.439 |
| 2 | 0.137 |
| 3 | 0.061 |
| 4 | 0.060 |

In August, 1961, we came upon a pole that we were in doubt about as to its soundness that had previously been treated. We changed out the pole and sent off a sample near the groundline to be analyzed.

Approximately 8 inches below the groundline area, three 1 inch cubes were removed at approximate equidistant locations on the periphery of the pole. Each cube was split into ½ inch radial sections. Sections representing the outer ½ inch were grouped together, as were those representing the second ½ inch. It was not feasible to remove sections representing the third ½ inch, etc., due to the "punky" structure of the wood.

Six separate quantitative analyses for sodium fluoride were performed on each group. The results are as follows:

| Amount NaF (lbs./cu. ft.) In First ½ Inch From Outside of Pole | Amount NaF (lbs./cu. ft.) In Second ½ Inch From Outside of Pole |
|---|---|
| .118 | .088 |
| .111 | .086 |
| .128 | .050 |
| .123 | .052 |
| .133 | .065 |
| .132 | .076 |
| .124 lbs. NaF/cu. ft. Average | .070 lbs. NaF/cu. ft. Average |

The analysis shows retention lower than is normally obtained and substantially below that of .439 pounds per cubic foot of the analysis just given above. It is a difficult problem to determine exactly why higher retention was not obtained. However, the Osmose people considered themselves at fault and, in the absence of more exact knowledge, gave two reasonable assumptions as follows:

1. Inadequate inspection. While decay can progress rapidly once it gets off to a running start, examination of the section furnished us leads us to believe that this pole was probably in the marginal category at the time of inspection and should have been noted on the report sheet.
2. Inadequate amount of material applied. We can see no other reason why retention did not measure up to that which could be reasonably expected in the area containing sound wood.

In January, 1963, we removed three poles for the expressed purpose of determining the retention and penetration of the Osmoplastic. These poles were Osmose treated in August, 1960, which totals 30 months since treated. For analysis, ½ inch to ¾ inch discs were removed approximately 6 inches below groundline. All excess Osmoplastic was thoroughly removed from the outside surface of these sections before the discs were cut. Determination of sodium fluoride was by the AWPA Standard A2 procedure and, for determining pentachlorophenol retention, the AWPA Standard A2 (Lime Ignition) tests were used. The results of this analysis are given in the following table:

## Osmoplastic Treated Pole Analysis

| Pole No. | Sodium Fluoride (Lbs./Cu. Ft.) 1st ½" | 2nd ½" | 3rd ½" | 4th ½" | 5th ½" | 6th ½" | Pentachlorophenol (Lbs./Cu. Ft.) 1st ½" | 2nd ½" |
|---|---|---|---|---|---|---|---|---|
| 5 | .323 | .216 | .187 | .168 | .186* | .237* | .007 | .000 |
| 8 | .692 | .242 | .168 | .134 | .080 | .068 | .037 | .000 |
| 9 | .398 | .186 | .150 | .125 | .116 | .108 | .018 | .000 |

*Non-creosote sapwood center (very small heartwood)

Also in January, 1963, we had performed an analysis made on a pole section that had been treated in 1960 with an application of Pol-Nu applied by the Martin Chemical Company. The analysis, therefore, for a determination of the retention of penta approximately 25 months after the groundline treatment. The table below shows the results of this analysis.

| | % Penta/Cu. Ft. 1st Half Inch | 2nd Half Inch | Expressed as Lb./Cu. Ft. 5% Penta-Petroleum 1st Half Inch | 2nd Half Inch |
|---|---|---|---|---|
| Ground Line | 0.2392 | 0 | 4.79 | 0 |
| 8" Below Ground Line | 0.5290 | 0.0483 | 10.58 | 4.7 |

Only the first and second half inch is shown in the table because no detectable quantity was found in the third and fourth half inch.

From these analyses, it can be seen that from pole to pole or from like sections in the same pole, retention differs. But this is not surprising because it is a well-known fact that poles in the same treating cylinder at the producers plant will not retain the same weight of preservative nor will penetration be the same. If this is true during initial treatment of the pole, why then shouldn't it be true when groundline preservative is applied. This point, to me, emphasizes the need for an inspection on a cyclic basis.

In the fall of 1960, the Osmose Wood Preserving Company, with our permission, treated 125 poles in two of our districts with a new preservative formulation, Osmotox, for pole groundline treatment for the purpose of evaluating its performance under field conditions.

In general terms, Osmotox is classified as both an oil soluble preservative and a water soluble preservative. By this combination, both wet and dry wood may be treated without distinction.Composition is based on four wood preserving materials of fungicidal and insecticidal value.

1. Creosote and coal tar naphtha
2. Butinox (tributyltin Oxide)
3. Sodium fluoride
4. Sodium borate

Increment borings are taken each year from certain of these poles for laboratory analysis. Thus far, the results are inconclusive.

The Osmose Wood Preserving Company has also applied both Osmoplastic "F" and Osmoplastic "B" to about 100 poles on our property for testing the field performances of these formulations.

The Bell Telephone Laboratory is credited with the development of the particular combination of fluoride, penta, and creosote which Osmoplastic "F" contains. In the Osmoplastic "B" a borate is substituted for the fluoride.

Following are the results of the analysis on the poles treated with Osmoplastic "F" in November of 1961. These poles were treated on one side with 1/4 inch of material and on the other side with 1/8 inch of material. Borings were taken in January, 1963, on both sides of these poles.

Determination of sodium fluoride was by AWPA Standard A2 procedure and for determining pentachlorophenol retentions AWPA Standard A2 (Lime Ignition) test was used.

There was very little difference in the retentions of pentachlorophenol and sodium fluoride between the two samples. The material, however, was only on these poles for about 14 months and it is possible that, over a longer period of time, the 1/4 inch application might have produced higher retentions. The tables below give the results of the analysis:

**Osmoplastic Treated Pole Analysis**

TABLE I – Material applied 1/8 inch in thickness

| Pole Number | Pentachlorophenol (Lbs./Cu. Ft.) | | | Sodium Fluoride (Lbs./Cu. Ft.) | | |
|---|---|---|---|---|---|---|
| | 1st ½" | 2nd ½" | Next 1" Segment | 1st ½" | 2nd ½" | Next 1" Segment |
| 17 | .59 | .28 | .003 | .45 | .14 | .18 |
| 19 | .81 | .12 | .04 | .24 | .15 | .10 |
| 20 | .79 | .14 | .02 | .42 | .22 | .20 |

TABLE II – Material applied 1/4 inch in thickness

| Pole Number | Pentachlorophenol (Lbs./Cu. Ft.) | | | Sodium Fluoride (Lbs./Cu. Ft.) | | |
|---|---|---|---|---|---|---|
| | 1st ½" | 2nd ½" | Next 1" Segment | 1st ½" | 2nd ½" | Next 1" Segment |
| 17 | .41 | .05 | .01 | .39 | .08 | .15 |
| 19 | .76 | .21 | .05 | .20 | .17 | .11 |
| 20 | .80 | .12 | .01 | .37 | .34 | .20 |

Poles Treated – November, 1961
Borings Taken – January, 1963

We are eager to participate in these field evaluations with the hopes of discovering a material which offers improved penetration and retention of toxic elements and will lower the cost per pole per year by further extending the retreatment cycle.

Much has been written on the economics of supplemental treatment of standing poles. Each utility's approach to the solution of this problem is different and, naturally, so it should be because different parameters surrounds the operations of each. All that I will say here on the economics is that, to justify a program of treating poles from strictly an economical basis, the cost of treating must be such that the cost of operation is equal to or less than when replacement poles are provided.

Of all the poles inspected. 5.85 per cent of these poles had outer decay 1 inch or less from the surface or interior decay more than 1 inch from surface. These poles required scraping which resulted in the circumference of the pole being reduced. Had these poles not been treated, it stands to reason that the need for replacing these poles would come at an early date. Should decaying poles remain undetected, the possibility of these poles becoming dangerous is very imminent. And this, gentlemen, is what we are trying to avoid. Detecting and eliminating the dangerous poles is sufficient justification for including a planned ground line treatment program in the operation of your plant.

To prevent damage to transmission poles from the pileated woodpecker, we wrap the poles with 2 x 2, 19 guage, wire mesh (hardware cloth) from the pole top to within 10 feet to 12 feet of the ground line. This has proven to be 95 per cent effective. On distribution poles, we are experimenting with No. 16 guage PVC and Polyethylene plastics. This is being used in lieu of hardware cloth so that the Basic Insulation Impulse Level of the structure can be maintained at a high value. Recently, we have coated a number of distribution poles with Koppers Woodpecker Repellent. It contains a pungent coal-tar derivative in a penetrating pentachlorophenol grease which can be applied in a thick coat with a 4 inch paint brush.

Periodically, the marsh lands of Louisiana are burned over by muskrat trappers. To protect poles in these areas from such fires, fireplate is applied around the bottom 8 foot section of the pole. This is a fire-resistive coating developed by the Research and Development Associates, Inc., in Fort Worth, Texas.

This concludes what one utility company is doing in trying to extend pole life in plant. But before I sit down, I would like to give credit where credit is due. In carrying out their work, the Osmose Wood Preserving Company crews, under the supervision of Hans Schirrmann, have worked in all 28 of the company's districts and, by some magical means, have managed to satisfy all 28 district managers. You operating people know from experience that this is by no means a small accomplishment. This class of service is worth something; however, it is difficult to put a dollar value on it. And even though it is not proved 100 per cent effective, we are pleased with our program thus far.

# KINDS OF PRESERVATIVES FOR WOOD POLES

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## KINDS OF PRESERVATIVES FOR WOOD POLES

The year 1963 marks the 55th year the major statistics of the wood preserving industry have been assembled and made available in published form. The data are collected and compiled by the Forest Service branch of the United States Department of Agriculture in co-operation with the American Wood-Preservers' Association.

From a simple 2-3 page report in 1908, the statistical study has grown into a most informative 32-page report listing the treating plants in this country and Canada, their locations, the total volume of wood treated and the amounts and kinds of preservatives used in the treatments. The information is then broken down into eight classes of treated materials; namely, poles, crossties, fence posts, piling, crossarms, lumber and timbers, switch ties and miscellaneous. Each class is then further broken down into species of wood (southern pine, Douglas fir, oak, ponderosa pine, lodgepole, etc.), and by kind and amount of preservative used for each species.

For the "kinds of preservatives for wood poles", the subject of this paper, it was therefore quite proper to turn to the section on poles in the latest report which is reproduced below as Figure 1 and to lift the information we need.

Figure 1 shows that the kinds of preservatives used for treatment of wood poles are:

| | Remarks |
|---|---|
| Creosote | 100% coal tar creosote |
| Creosote-coal tar solution | Usually 80% creosote, 20% coal tar by volume. |
| Creosote-pentachlorophenol | 98% creosote, 2% pentachlorophenol, by weight. |
| Creosote-petroleum | 50% creosote, 50% heavy petroleum by volume. |
| Petroleum-pentachlorophenol | 95% petroleum, 5% pentachlorophenol, by weight. |
| Other | Usually salt treatments based on salts of chromium, arsenic, copper, zinc. |

Information on the percentages of poles treated with each preservative likewise appears in Figure 1 and is recapped here for convenient reference:

| | % of Poles Treated | |
|---|---|---|
| | Under Pressure | By Pressure and Nonpressure |
| Creosote and creosote-coal tar | 55 | 52 |
| Creosote–2% pentachlorophenol | 11 | 10 |
| Creosote-petroleum | 4 | 3 |
| Petroleum-pentachlorophenol | 29 | 34 |
| Other | 1 | 1 |

The designation "poles" as used in Figure 1 includes both poles for telephone and utility use and poles for pole-type building construction. Steps are under way to report the two groups separately and this will probably become standard practice in a year or two.

A word on clarification of creosote terms. At treating plants one often hears the expression "Grade 1 Oil" or "Grade 1 Creosote". Purchase orders often carry similar designations. The Federal Specifications are titled "Coal-Tar Creosote, Technical". The AWPA specifications simply say "Creosote".

There is little need for confusion in spite of what appears to be several different designations. Creosote has been in use for over one hundred years and at one time, around 1917, there were three grades – Grades 1, 2,, 3. Grades 2 and 3 were lighter, less permanent and less desirable and gradually disappeared from the market. "Grade 1 Creosote" became the title of the AWPA Standard. Later on

Figure 1

Table 5.—Poles Treated in 1961 by Kind of Wood and Preservative, and Total Treated 1960–61 *

(Number of poles)

| Kind of wood | Creosote and creosote-coal tar | Creosote-penta-chlorophenol | Creosote-petroleum | Petroleum-penta-chlorophenol | All other | Total 1960 | Total 1961 | Percent |
|---|---|---|---|---|---|---|---|---|
| **PRESSURE TREATMENT** | | | | | | | | |
| Douglas fir | 77,723 | [1] | 4,298 | 204,722 | [1] | 317,289 | 318,631 | 6 |
| Jack pine | [1] | 0 | [1] | 161,564 | 0 | 141,638 | 173,526 | 4 |
| Lodgepole pine | [1] | 0 | [1] | 197,576 | [1] | 273,385 | 216,079 | 4 |
| Norway pine | [1] | [1] | [1] | [1] | [1] | 101,781 | 72,326 | 2 |
| Ponderosa pine | 9,602 | 0 | [1] | 29,091 | [1] | 35,130 | 52,442 | 1 |
| Southern pine | 2,567,398 | 494,928 | 128,393 | 769,173 | 6,352 | 4,183,393 | 3,966,244 | 80 |
| Western red cedar | [1] | [1] | [1] | 18,346 | 0 | 33,876 | 19,304 | 0 |
| All other and mixed | 46,777 | [1] | 0 | [1] | 13,527 | 39,988 | 133,308 | 3 |
| Total | 2,714,578 | 569,309 | 178,801 | 1,462,030 | 27,142 | 5,126,480 | 4,951,860 | |
| Percent | 55 | 11 | 4 | 29 | 1 | | | 100 |
| **NONPRESSURE TREATMENT** | | | | | | | | |
| Douglas fir | 0 | 0 | 0 | 13,016 | 0 | 19,444 | 13,016 | 3 |
| Jack pine | 0 | 0 | 0 | [1] | 0 | [1] | [1] | [1] |
| Lodgepole pine | [1] | 0 | 0 | 31,740 | 0 | 35,135 | [1] | [1] |
| Ponderosa pine | 0 | 0 | 0 | [1] | 0 | [1] | [1] | [1] |
| Southern pine | [1] | 0 | 2,877 | [1] | 0 | 6,036 | 5,055 | [1] |
| Western red cedar | 108,716 | 0 | 0 | 216,073 | 0 | 313,888 | 324,789 | 62 |
| All other and mixed | 4,608 | 0 | 0 | 100,086 | 0 | 114,193 | 104,694 | 20 |
| Total | 121,787 | 0 | 2,877 | 395,207 | 0 | 520,590 | 519,871[2] | |
| Percent | 23 | | 1 | 76 | | | | 100 |
| **PRESSURE AND NONPRESSURE** | | | | | | | | |
| Total | 2,836,365 | 569,309 | 181,678 | 1,857,237 | 27,142 | 5,647,070 | 5,471,731 | |
| Percent | 52 | 10 | 3 | 34 | 1 | | | 100 |

[1] Withheld to avoid disclosure of individual company operations.
[2] Includes 85,456 poles given butt treatment, 249,284 full-length treatment, and 185,131 not specified.

*Proceedings, American Wood-Preservers' Association, Vol. 58 (1962) page 263.

during a general review and simplification of all its Standards, the Association dropped the "Grade 1" part of the title with the result that the Standard now simply reads "Creosote". Since all the creosote used for wood preservation comes from coal tar, the expression coal-tar creosote is easily explained.

So it is that the various expressions listed above refer to the same material and are simply familiar terms used interchangeably within the wood preserving industry. Creosote-Coal Tar Solution and Creosote-Petroleum Solution are blends of creosote with crude tar or petroleum.

The six kinds of preservatives being used today; namely creosote, creosote-coal tar solutions, creosote plus 2% dry penta, creosote-petroleum, petroleum-5% penta and water soluble salt solutions do not represent a great problem for the treater except that the materials must be handled in a careful manner to keep contamination of one with another to a minimum. The solution to this problem rests with the proper design of the plant and good housekeeping. The quality of the preservatives can be readily checked by the plant laboratory thus enabling the treating supervisor to maintain the preservatives up to specification at all times.

There is one other phase of pole treatment where the use of preservatives is sometimes indicated. . .protection during air-seasoning. It appears that where poles are to be stacked for air-seasoning in warm humid areas, for even a few weeks, there exists the possibility of infection from mold, stain and decay fungi which can impair the value of the poles, if not diminish their strength properties.

To avoid this possibility, the peeled poles are sometimes given what is known as a pre-treatment using a water solution of a salt-type preservative. Several preparations based largely on sodium pentachlorophenol plus an alkalizer are available under various trade names. A paper read just last month at the AWPA Convention brought out that green southern pine poles soaked for 15 minutes in a 30% ammonium bi-fluoride solution and allowed to season in open uncovered piles remained fully protected against decay and stain fungi for an entire year. A good pre-treatment assures that the white stock will be sound when it is ready for the final treatment.

Thank you.

# RETENTION AND SERVICE PERFORMANCE

By

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## RETENTION AND SERVICE PERFORMANCE

The service life of a pole is the most effective and accurate way to determine the true values of the treatment, retention and preservative. But with the majority of preservatives used in treating poles today this would be an extremely slow method of quality control. For a quick guide the producer in the plant uses the amount of preservative retained in the pole, the depth of penetration and, equally as well, the distribution of preservatives in the pole for his standards in making a quality product.

The preservatives that will be discussed in this paper will be coal tar creosote, creosote-coal tar solution, and creosote to which 2% pentachlorophenol has been added. These three solutions accounted for about 63% of the preservatives used in the treatment of poles in 1961.[1]

The species of wood discussed in this paper will be the Southern Pines; specifically, long leaf, slash, loblolly, and short leaf. This group accounted for about 72% of all the poles treated in 1961 and about 64% of the poles treated were here in our Southern Coast Region.[1]

Service life records in the past, laboratory evaluation, and field test data have given the approximate amounts of preservatives essential for protection of poles under various uses and locations.

The pressure treatment of wood poles by preservation is influenced by many factors. At the risk of repeating some parts of the preceeding paper on "Movement of Preservatives in Wood", these facts should be again mentioned:

> The physical structure of the wood, the condition of the wood prior to treatment and the treating procedure. Treating procedure can be controlled and varied as conditions justify. The general condition of the wood prior to treatment can partially be controlled if all the seasoning cycles are under the control of the producer. The anatomy is most difficult to control and this can be done only to a very limited degree.

Retention of preservatives essentially involves the amount of oil that remains in the wood after the liquid is forced through the capillary structure by an external pressure. "Both penetration into the capillaries and flow through them are highly dependent upon capillary size and arrangement. The volume of the flow of liquid in a unit time enlarges directly as the fourth power of the radius. Creosote and oil borne preservatives do not penetrate or pass through the substance constituting the cell walls of the wood but move from cell to cell through the communicating pits."[2] In softwood the cells form: (a) tracheids, which serve two purposes, sap conductive and mechanical support; (b) rays, which store and conduct food materials in horizontal direction; (c) vertical and radial intercellular canals or resin ducts. Treatment of softwood poles depends mainly on the movement of the preservative through the inside of tracheids. Movement from cell to cell is effected through small valve-like openings called bordered or simple pits. As the tree grows during the spring and summer, two different types of concentric rings are added. The springwood ring is more porous and lighter in density than the summerwood ring. Generally speaking, the springwood will retain more preservative because of the lighter density but some data has shown just the opposite.[3] The smaller voids in summerwood rings reduce the available volume for retention of preservative. The resin ducts allow penetration and retention to be increased in both the longitudinal and radial directions. Rays in softwood aid somewhat in radial penetration. The part of the tree which is active in supplying food and growth is called the sapwood. The inner part of the tree that does not supply growth functions is called the heartwood. The thickness of the sapwood depends on the growth rate, climate and soil conditions, and density of tree growth in the woods. Generally, the larger mature trees have less sapwood. The sapwood in pine is usually easy to penetrate providing the wood has been conditioned properly. The heartwood is difficult to penetrate to any appreciable depth in Southern pine poles.

The weight per unit volume (lb./cu. ft.) or density of the wood determines the space available for air or liquid. The specific gravity of wood substance is about 1.56. An average specific gravity value for Southern pine oven dried is about 0.55. From published tables[3] the theoretical available air

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[1] Gordon DeMerrick Report 1961

[2] Wood Preservation – Hunt and Garratt

[3] USDA Bulletin 40 – Wood Preservation

space in treatable wood from this data is about 62%. If the pole contains 30% moisture this air space would be reduced to about 48%. This means that there is available for retention of preservative 48% or .48 cu. ft. of treatable voids. The theoretical maximum retention of a preservative with a specific gravity of 1.07 would be 42.77 lb./cu. ft. It is usually not practical to obtain net retention of above 80-85% in the available air space. If the pole contained 20% untreatable heartwood, the maximum retention in a pole would be reduced by treating and heartwood factor to 27.37 lb./cu. ft. The density of the wood in pole varies generally from a higher value in butt section to a lower value at the top. Also, the density will vary in radial samples taken at different points in the same circumference section. These variations in density will cause variations in retention throughout the pole and in any one area of a cross section. Treatment procedures that can be observed that will give more uniform type retentions are: Treating poles of the same general size and length; not mixing poles of various seasoning ages in the same charge; and using proper conditioning and treating schedules for the specific seasoning condition of the poles. If poles of different sizes are treated together the ratio of volume to surface area will effect the retention. The smaller poles will retain more preservative per unit volume than larger ones. If green poles are treated with seasoned poles and the charge conditioned for the seasoned poles only, the green poles would not have sufficient retention or penetration. And, of course, the treating operator will have to know something of the background of poles prior to treating so that the poles can be steam conditioned properly, if necessary, given the proper amount of air pressure, injected with the proper amount of preservative during pumping period, and given the proper vacuum and final steam cleaning cycle if required.

Retention is the amount of preservative left in the wood voids after treatment expressed in pounds per cubic foot. In the creosote treatment, the net retention is expressed in lb/cu. ft.. of the total creosote retained in the wood. In oil-carried or water-soluble type salt preservative treatments, the net retention is expressed in lb./cu. ft. of the dry salt or chemical retained in the wood. Two terms are usually used in discussion of retention of preservative. Gross absorption is the amount of preservative injected into the wood while in the treating cylinder. Net retention is the final amount left in wood after treatment.

In plant operations, net retention is usually measured by the difference in preservative at the start of the treatment and at the end of the treatment usually referred to as guage retention. Several methods are used to obtain these data: (1) The actual measurement of liquid level in treating tank by the use of a float attached to guage board with a vernier scale for reading preservative changes in feet or volume, or a float attached to a device to change mechanical movement into varying electrical current for remote station reading; (2) Measurement of liquid levels by the use of manometer type measurement devices; (3) Actual weighing of treating tank by scales to the tank; (4) Actual weighing of the poles after treatment. Net retention determined by the first three methods above gives the total amount of preservative used to treat the wood, coat the treating cylinder and tram, and any oil not returned to the cylinder. The preservative loss during a treatment that is not actually retained in the wood is usually more than offset by interchange of water in the wood oil. In a 40,000 gallon treating tank a normal water interchange for seasoned poles of 0.2% would amount to 80 gallons of preservative. Green poles would exchange 0.5% to 1% water for preservative during treatment.

After a charge of timber has been treated, it is not possible to determine, either by inspection or dry analysis, whether the specified amount of preservative per cubic foot has been retained in the wood. This is due to the fact of the nonuniform distribution of preservative throughout the length of the poles makes it impracticable to obtain a correct average sample of impregnated timber, without destroying most of it.[4] The pole buyer should deal with reputable treating companies or have some type of inspection by his own personnel or a third party inspector to insure getting the specified retention of preservative required.

There is a growing move in the use of result-type specification on the finished product rather than an inspection of each step during production. Retention of preservative in these specifications

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[3] USDA Bulletin 40 — Wood Preservation
[4] Hunt and Garratt — Wood Preservation, P. 252

is usually determined by a toluene extraction assay of an increment boring from a certain zone and location in the pole.[5] Considerable data has been obtained on the one and one-half inch section taken from a two-inch boring by removing the outer half inch of treated wood. Interesting data is presented by Lumsden[6] and others on the ranges in retention of charges assayed at various plants. Retention requirements have been based on assays of a large number of poles of various ages in service, averaging the various retentions at which decay was noted against the poles in sound condition.

Borings taken for assay can also be used in determining penetration. The borings will assay the retention of the sample only, not the entire cross section or entire pole average retention and usually these borings are grouped together in lots of twenty borings so that only an average retention of twenty borings is obtained. In an 8 lb./cu. ft. charge, the individual poles will vary from 3 lb./cu. ft. to 13 lb./cu. ft. In the data mentioned 40% of the poles contained less than 5 lb./cu. ft.[6] Hudson has developed and reported on a colorimetric method of assaying poles on an individual basis.[7] This method is more rapid than the toluene extraction and has great promise as a plant retention assay aid. The attached copy of Data Sheet 1 & 2 from reference 7 shows a cooperative test run by seven treating plants using this method. The main advantage of the individual assay regardless of the method used is that the pole with a low retention can be retreated in the plant before going out into service. This should tend to upgrade the service life of poles and eliminate most of the small percentage of early failures.

Most utilities in the South now specify 8, 10, or 12 lb./cu. ft. retention in poles. The 8 lb./cu. ft. treatments now in the south are usually a 2% penta in creosote solution. One of the reasons for using this solution at the 8 lb./cu. ft. retention level rather than a 10 or 12 lb./cu. ft. creosote retention was doubt in obtaining a treatment that would not bleed. The 10 and 12 lb./cu. ft. retention with creosote or creosote-coal tar solution are now in the majority use in the south and no objectionable bleeding conditions are generally reported.

Some of the advantages of using higher retention than the minimum needed for protection are:

1. The higher retention provides a better reserve against preservative loss by fluid exudation and evaporation.
2. The distribution and penetration are usually better and more uniform.
3. If the preservative has uncertain toxic values, the heavier retentions help protect against deficiences of this value.
4. Good retentions help protect against the possibility of not providing sufficient treatment in the more resistant to treat poles in a charge.
5. Increased retention reduces the variation between maximum and minimum retention obtained in a charge as found when colorimetric inspection of individual poles for retention is used.
6. The small additional cost for the higher retention is economical for the protection of the expected life of the pole. This is especially true where poles might be held in storage for some time prior to placing in service.

Service data records on poles are reported each year by Committee U-4 of the AWPA. This committee's work is outlined to collect and publish service records on older treated poles, get full information and initiate service records on new installations with particular reference to new wood species, new preservatives and new treating methods with a view toward reporting on these at about five-year intervals. In the 1962 report is a complete listing by type of treatments and preservatives of previous U-4 reports on pole service.

The 1961 report shows REA's incidence of decay area map and service data. The data in the 1961 report shows that 2,167,443 or 75.8% of all poles in line were Southern pine poles. Poles replaced or stubbed in an 8-year period amounted to 1.30%. Decay accounted for 73.41% of all replacements for

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[5] AWPA Manual A-6-59

[6] Lumsden, G. Q.—Fortified Wood Preservatives of Southern Pine Poles. Forest Products Journal, Vol. X, 1960. AWPA Proceedings, 1961, P. 370

[7] A U.S. Patent 2,992,902—July 18, 1961; b. AWPA 1957, P. 84; c. AWPA 1962, P. 225

all species. The two highest decay-hazardous regions are here in the south, the Gulf and Atlantic Coastal areas being the highest. The following table shows the causes for replacements during an 8-year period for Southern pine poles, all preservatives, all causes, regions 5 and 6 based on total poles in line.

| | Percent of Poles in Service-April 1951 through March 1959 | | |
|---|---|---|---|
| | Decay Hazard Regions | | All Regions |
| | 5 | 6 | |
| Decay | 1.02 | 3.03 | .92 |
| Lightning | .09 | .13 | .12 |
| Wood Pecker | .13 | .15 | .12 |
| Sleet, frost, snow | .02 | .00 | .02 |
| Wind | .06 | .03 | .05 |
| Vechicles and machinery | .05 | .04 | .04 |
| Age or obsolescence | .01 | .11 | .01 |
| Other | .02 | .04 | .02 |
| All causes | 1.40 | 3.63 | 1.30 |
| Total number of poles | 723,097 | 244,162 | 2,167,443 |
| Average age of poles removed | 11.2 | 12.2 | 11.7 |

For all species and treatments and for all decay-hazard regions, groundline and below groundline areas accounted for 82.5% of the decay found in poles. The upper one-fourth of the pole had the most damage in respect to woodpecker attack (79.7%) and lightning (89.4%). Sleet, frost and snow caused breaks occuring mostly in the groundline (38.5%) or in the lower one-fourth of pole height (37.3%). A detailed study of the results are available in REA Bulletin 45-7 Revised 1961.

The following table is taken from the 1953 AWPA Proceedings Report of U-4 and is data on creosoted Southern pine poles in the southern area. In spite of the large number of utility poles in service there is very little published data on their performance. Most of these data are from records ten years old and current inspection of these poles has not been received but a general trend can be seen showing the higher the retention the longer the expected service life. Where no failures have been reported, no approximation of service life is shown because only one of the two points on average service life table is available.

Also listed as reported are service data from several of the Southern utilities contacted for current information in performance of creosoted Southern pine poles.

Some Southern Pine Creosote Pole Records in the Southern Area – From Pole Service Records from 1953 U-4 Report in the AWPA Proceedings

| Owner | Location | No. In Test | Date Inst. | Date Insp. | % Removal Decay and Termite | Estimate Service Life Years* |
|---|---|---|---|---|---|---|
| | | **Southern Pine Creosote 16 lb. Full Cell Treatment** | | | | |
| Gulf, Colorado & Sante Fe Rwy. | Texas | 370 | 1908 | 1928 | 0 | |
| | | **Southern Pine Creosote 14 lb. Full Cell Treatment** | | | | |
| TVA | Tenn | 289 | 1928 | 1941 | 0 | |
| | | **Southern Pine Creosote 12 lb. Full Cell Treatment** | | | | |
| Amer. T & T Co. | Va. | 122 | 1897 | 1923 | 9.0 | 42 |
| | Va. | 1523 | 1897 | 1923 | 3.2 | 50+ |
| | Ala. & Miss. | 1602 | 1897 | 1927 | 13.5 | 45 |
| Duke Power Co. | N.C. & S.C. | 2029 | 1913 | 1942 | 21.5 | 38 |
| | N.C. & S.C. | 2029 | 1913 | 1948 | 26.4 | 45 |
| Western Union Tel. Co. | La. | 2347 | 1915 | 1940 | 8.2 | 42 |
| Gulf States Utl. | Texas | 580 | 1913 | 1935 | 1.25 | 50+ |
| | | 580 | 1913 | 1939 | 30.0 | 32 |
| FEC Rwy. Co. | Fla. | 1150 | 1926 | 1940 | 0 | |
| | | **Southern Pine Creosote 12 lb. Empty Cell** | | | | |
| Ala. Power | Ala. | 682 | 1926 | 1940 | 2.6 | 29 |
| | | **Southern Pine Creosote 10 lb. Empty Cell** | | | | |
| Ala. Power | Miss. | 1620 | 1925 | 1938 | 1.9 | 28 |
| | Ala. | 423 | 1928 | 1938 | 21.3 | 15 |
| TVA | Tenn. | 472 | 1927 | 1940 | 0 | |
| Central Power & Light | Texas | 370 | 1932 | 1943 | .27 | 39 |
| Va. Power & Light | Va. | 286 | 1931 | 1943 | 0 | |
| | | **Southern Pine Creosote 8 lb. Empty Cell** | | | | |
| Dallas Power & Light | Texas | 26360 | 1923 | 1938 | .5 | 42 |
| TVA | Tenn. | 451 | 1930 | 1940 | 0 | |
| Sou. Bell T & T | N.C. | 121 | 1931 | 1954 | 10.7 | 34 |
| | N.C. | 198 | 1931 | 1948 | 1.0 | 44 |
| | Ala. | 106 | 1935 | 1948 | 1.8 | 30 |

*FPL Bulletin 886 USDA

### Florida Power Corporation

**Number of Transmission Line Wood Poles Replaced by Years**

| | 1959 | 1960 | 1961 | |
|---|---|---|---|---|
| | | | No. | % |
| Woodpecker Damage | 123 | 131 | 198 | 0.83 |
| Total Decay | 131 | 172 | 287 | |
| a. Groundline Decay | 110 | 144 | 223 | 0.94 |
| b. Top Decay | 21 | 28 | 64 | 0.27 |
| Total | 254 | 303 | 485 | 2.04 |

Total poles in line at end of 1961: 23,807

NOTE: Removals do not include reconstruction work, road work, increase line clearness or Hurricane "Donna" in 1960. Top decay includes all from 2' above the groundline to the top of pole. Groundline decay is from 2' above groundline to the pole butt. Total average life over a 3 year period (1959-61) for woodpecker attack of poles: 8.8 years. Retention requirement 9 lb./cu. ft. by assay. Penetration requirement as covered by AWPA requirements from specification. Preservative – coal tar creosote.

*Information furnished through the courtesy of I. L. Garcia, General Engineer, Florida Power Corporation*

### Gulf States Utilities

Prior to 1941 8 lb./cu. ft. of creosote was used. From 1941 to 1945 10 lb./cu. ft. on distribution and 12 lb./cu. ft. of creosote was used on transmission. Since 1946 all poles have been treated 12 lb./cu. ft. with creosote.

*Courtesy J. B. Colthrop, Operations Manager*

### Central Power and Light Company

| Length | Retention lb./cu. ft. | Preservative |
|---|---|---|
| 45' and under | 10 | Coal tar creosote |
| 50' and over | 12 | Coal tar creosote |

Prior to 1950 a large number of poles were 8 lb./cu. ft. creosote with some post-war poles treated with combination petroleum treatments. No service records as such are kept. Some groundline treatment is done.

*Courtesy O. H. Boyer, Distribution Engineer*

### Alabama Power Company

Majority of poles since 1925 have been treated with 80/20 creosote coal tar creosote to a 12 lb./cu. ft. retention Purchases of poles have fluctuated during the years due to economical conditions. Some utilities acquired since 1925 did not use the 12 lb./cu. ft. treatment but their poles are included in these data.

**Creosoted Pole Replacements – by Causes for Replacement in Percent**

| Years | Butt Rot | Top Rot | General Rot | Total Poles |
|---|---|---|---|---|
| 1953-56 | 69 | 6 | 25 | 5,223 |
| 1953-57 | 69 | 6 | 25 | 6,597 |
| 1953-58 | 70 | 6 | 24 | 8,292 |
| 1953-59 | 72 | 6 | 22 | 9,379 |
| 1953-60 | 71 | 6 | 23 | 10,949 |
| 1953-61 | 71 | 7 | 23 | 13,846 |

**Replacement Due to Decay by Age Groups; Expressed as Percent of Total Pole Failures**

| Years | 30 yrs. old | 20-30 yrs. | 10-20 yrs. | Less than 10 yrs. | Total Poles |
|---|---|---|---|---|---|
| 1953-56 | 29 | 40 | 30 | 1 | 5,223 |
| 1953-57 | 32 | 38 | 28 | 2 | 6,597 |
| 1953-58 | 38 | 34 | 28 | 2 | 8,292 |
| 1953-59 | 37 | 34 | 27 | 2 | 9,379 |
| 1953-60 | 39 | 34 | 26 | 2 | 10,949 |
| 1953-61 | 42 | 33 | 24 | 1 | 13,846 |

NOTES: General decay and rot are the same thing. Decay is anywhere in the length of the pole above the groundline not included in top rot. Because of variation in the number of poles installed each year and the fact a complete life cycle has not been completed, the factual data of percentages are not expected to be stablized. Present estimated depreciation of pole 3%/year average life is used.

| Years | Total Replacement | Total Poles in Service | % Renewal |
|---|---|---|---|
| 1953-56 | 5,223 | 580,983 | 0.898 |
| 1953-57 | 6,597 | 592,368 | 1.114 |
| 1953-58 | 8,292 | 602,718 | 1.376 |
| 1953-59 | 9,376 | 612,213 | 1.532 |
| 1953-60 | 10,949 | 622,763 | 1.758 |
| 1953-61 | 13,896 | 634,000 | 2.184 |

*Courtesy P. C. O'Shee, Superintendent of Distribution*

**Georgia Power Company – Transmission Poles – 10 lb./cu. ft. creosote retention**

Poles are dated when installed. Since 1955 reason for removal and age have been recorded. The data below does not include major rebuilding of lines which required poles to be replaced, but does include isolated replacement from causes such as decay, bird holes, lightning, fire and improvement of clearance of other line crossings.

| Year | No. Poles Replaced | Avg. Age at Replacement |
|---|---|---|
| 1955 | 672 | 21.00 |
| 1956 | 878 | 21.03 |
| 1957 | 1055 | 19.86 |
| 1958 | 888 | 20.44 |
| 1959 | 891 | 22.80 |
| 1960 | 1202 | 21.00 |
| 1961 | 1089 | 20.46 |

At the end of 1961, 95,003 pressure treated wood transmission poles were in service. Replacement in 1961 for causes listed above amounted to 1.15%. This indicates a service life in excess of 86 years although the average age at replacement for the last 7 years shows a trend at 20-22 years. More time will be needed to collect data in order to arrive at a true average life.

Percent breakdown of the 1961 replacements are:

| | | | |
|---|---|---|---|
| Decay | 51.23 | Highway improvement | 0.83 |
| Bird Holes | 31.77 | General changes | 0.28 |
| Lightning | 6.80 | Other causes | 2.99 |
| Clearance | 6.15 | Total | 100.00 |

*Courtesy J. T. Allen, Superintendent Transmission*

Data Sheet 1 (Portion of Table 1, AWPA Proceedings, 1962, P. 236)

| Overall | | | | Overall | | | |
|---|---|---|---|---|---|---|---|
| 124–8 lb. per cu. ft. charges | | | | 50–10 lb. per cu. ft. charges | | | |
| Toluene extraction (1) | Average for 20 individual colorimetric tests (2) | Colorimetric test on 20 borings combined (3) | Gauge retention (4) | Toluene extraction (1) | Average for 20 individual colorimetric tests (2) | Colorimetric test on 20 borings combined (3) | Gauge retention (4) |
| 7.02 | 6.37 | 6.35 | 8.30 | 6.97 | 6.80 | 7.25 | 10.00 |
| 7.59 | 7.07 | 7.61 | 7.71 | 6.65 | 6.98 | 7.00 | 10.18 |
| 9.34 | 8.91 | 9.65 | 8.90 | 8.76 | 7.82 | 8.75 | 9.18 |
| 7.76 | 7.54 | 7.25 | 8.98 | 8.86 | 8.56 | 9.00 | 9.39 |
| 8.81 | 8.55 | 8.45 | 9.20 | 9.47 | 9.36 | 9.25 | 10.16 |
| 8.00 | 7.08 | 7.15 | 8.54 | 13.15 | 12.19 | 12.00 | 11.94 |
| 7.51 | 7.39 | 7.45 | 8.67 | 9.92 | 9.86 | 10.25 | 10.44 |
| 8.29 | 8.00 | 8.35 | 8.99 | 9.69 | 9.33 | 10.25 | 11.88 |
| 7.73 | 6.52 | 7.25 | 8.47 | 8.30 | 9.31 | 8.25 | 10.09 |
| 7.22 | 6.53 | 6.85 | 8.37 | 10.22 | 10.99 | 10.25 | 9.62 |
| 10.28 | 9.90 | 9.85 | 8.31 | 11.01 | 10.18 | 10.50 | 12.49 |
| 8.20 | 7.68 | 7.95 | 8.50 | 8.33 | 9.24 | 9.25 | 7.93 |
| 7.61 | 6.83 | 7.15 | 7.77 | 8.65 | 8.95 | 8.75 | 9.95 |
| 9.13 | 8.60 | 8.65 | 8.86 | 10.39 | 10.40 | 10.50 | 11.35 |
| 8.48 | 7.57 | 7.85 | 8.77 | 10.31 | 11.94 | 12.00 | 10.47 |
| 7.80 | 7.06 | 7.15 | 9.22 | 9.51 | 11.18 | 10.25 | 9.46 |
| 7.68 | 7.13 | 7.15 | 8.33 | 8.79 | 11.27 | 11.15 | 9.42 |
| 7.79 | 7.45 | 7.55 | 7.72 | 9.37 | 9.77 | 9.75 | ——— |
| 8.24 | 7.78 | 7.75 | 8.42 | 9.65 | 8.72 | 8.75 | 9.64 |
| 8.43 | 7.68 | 8.05 | 8.85 | 8.97 | 9.04 | 8.65 | 9.29 |
| 7.66 | 7.24 | 7.75 | 8.91 | 9.92 | 10.45 | 9.75 | 10.20 |
| 7.80 | 7.10 | 7.05 | 8.57 | 9.34 | 10.68 | 10.65 | 10.91 |
| 8.67 | 7.73 | 8.15 | 8.79 | 10.17 | 11.54 | 9.90 | 9.74 |
| 8.36 | 8.60 | 8.65 | 9.15 | 9.59 | 9.55 | 9.25 | 10.16 |
| 7.29 | 7.17 | 7.06 | 9.02 | 8.97 | 9.19 | 9.25 | 10.29 |
| 8.12 | 7.58 | 7.78 | 8.61 | 9.40 | 9.73 | 9.63 | 10.18 |
| Statistics of differences between toluene extraction and colorimetric tests | | | | | | | |
| | − 0.54 | − 0.34 | | | + 0.33 | + 0.24 | |
| | 1.39 | 1.16 | | | 1.22 | 1.11 | |
| | 0.28 | 0.23 | | | 0.24 | 0.23 | |
| | 0.838 | 0.845 | | | 0.803 | 0.805 | |
| | 220 | 517 | | | 532 | 498 | |
| | −1.11 to + 0.04 | −0.80 to + 0.13 | | | −0.17 to + 0.83 | −0.19 to + 0.66 | |
| | −3.22 to + 2.24 | −2.66 to + 1.98 | | | −2.11 to + 2.77 | −1.98 to + 2.46 | |

Statistics of differences between colorimetric tests on 20 individual borings and 20 borings tested as composite sample

| | | |
|---|---|---|
| | + 0.20 | − 0.10 |
| | 0.62 | 0.83 |
| | 0.12 | 0.17 |
| | 0.925 | 0.900 |
| | 200 | 1164 |
| | −0.12 to + 0.51 | −0.44 to + 0.23 |
| | −1.04 to + 1.44 | −1.79 to + 1.56 |

Retention of Creosote in Individuol Southern Pines Poles os Determined Colorimetricolly

Doto Sheet 2 (Toble 3, AWPA Proceedings, 1962, P. 237)

| Retention Creosote, lb. per cu. ft. | Designotion of Co-operotor | | | | | | | Overoll | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 5 groups treoting to 8-lb. per cu. ft. nominol retention | | | 2 groups treoting to 10-lb. per cu. ft. nominol retention | | |
| | A | B | C | D | E | F | G | Number of Poles | Percent of Poles | Cumulo-tive Percent | Number of Poles | Percent of Poles | Cumulo-tive Percent |
| NUMBER OF POLES HAVING RETENTION SHOWN IN COLUMN AT LEFT | | | | | | | | | | | | | |
| 2 | 1 | | | | | 2 | 1 | 4 | 0.2 | 0.2 | | | |
| 3 | | 2 | 8 | 2 | | 12 | 17 | 33 | 1.3 | 1.5 | 8 | 0.8 | 0.8 |
| 4 | 34 | 9 | 9 | 12 | 6 | 36 | 45 | 136 | 5.5 | 7.0 | 15 | 1.5 | 2.3 |
| 5 | 68 | 42 | 20 | 74 | 22 | 75 | 87 | 346 | 14.0 | 21.0 | 42 | 4.2 | 6.5 |
| 6 | 85 | 48 | 41 | 92 | 48 | 64 | 78 | 367 | 14.8 | 35.8 | 89 | 8.9 | 15.4 |
| 7 | 70 | 85 | 35 | 75 | 38 | 67 | 13 | 310 | 12.5 | 48.3 | 73 | 7.3 | 22.7 |
| 8 | 69 | 93 | 36 | 66 | 79 | 73 | 109 | 410 | 16.6 | 64.9 | 115 | 11.5 | 34.2 |
| 9 | 58 | 76 | 71 | 49 | 75 | 57 | 18 | 258 | 10.4 | 75.3 | 146 | 14.7 | 48.9 |
| 10 | 40 | 59 | 73 | 29 | 72 | 48 | 81 | 257 | 10.4 | 85.7 | 145 | 14.6 | 63.5 |
| 11 | 36 | 36 | 52 | 15 | 20 | 22 | 30 | 139 | 5.6 | 91.3 | 72 | 7.2 | 70.7 |
| 12 | 20 | 14 | 39 | 14 | 40 | 24 | 11 | 83 | 3.4 | 94.7 | 79 | 7.9 | 78.0 |
| 13 | 4 | 12 | 39 | 14 | 31 | 13 | 9 | 52 | 2.1 | 96.8 | 70 | 7.0 | 85.0 |
| 14 | 5 | 11 | 33 | 9 | 26 | 2 | | 27 | 1.1 | 98.9 | 59 | 5.9 | 91.5 |
| 15 | 4 | 9 | 10 | 13 | 17 | 1 | | 27 | 1.1 | 99.0 | 27 | 2.7 | 94.2 |
| 16 | 3 | 1 | 5 | 8 | 6 | | 1 | 13 | 0.5 | 99.5 | 11 | 1.1 | 95.3 |
| 17 | | | 13 | | 9 | | | | | | 22 | 2.2 | 97.5 |
| 18 | | 1 | 8 | 3 | 10 | | | 4 | 0.2 | 99.7 | 18 | 1.8 | 99.3 |
| 19 | 3 | | 3 | 2 | 1 | | | 5 | 0.2 | 99.9 | 4 | .4 | 99.7 |
| 20 | | | 1 | 1 | | | | 1 | trace | 99.9 | 1 | .1 | 99.9 |
| 21 | | | | | | | | | | | | | |
| 22 | | | | | | | | 1 | trace | 99.9 | | | |
| 23 | | | | 1 | | | | 1 | trace | 100.0 | | | |
| 24 | | | | 1 | | | | | | | | | |
| Total | 500 | 498 | 496 | 480 | 500 | 496 | 500 | 2474 | | | 996 | | |
| Average retention lb. per cu. ft. | 7.7 | 8.2 | 9.9 | 8.0 | 9.6 | 7.5 | 6.5 | | 7.6 | | | 9.7 | |

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